DOCUMENT RESUME

ED 336 601 CE 058 994

TITLE	Related Views & Descriptive Geometry. Drafting Module 4. Instructor's Guide.
INSTITUTION	Missouri Univ., Columbia. Instructional Materials Lab.
SPONS AGENCY	Missouri State Dept. of Elementary and Secondary Education, Jefferson City. Div. of Vocational and Adult Education.
PUB DATE	91
NOTE	223p.; For related documents, see CE 058 991-998. Modules 7-8 have not yet been developed.
AVAILABLE FROM	Instructional Materials Laboratory, University of Missouri, 2316 Industrial Drive, Columbia, MO 65202 (order no. 70-4004-I: $27.00).
PUB TYPE	Guides - Classroom Use - Teaching Guides (For Teacher) (052)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Competency Based Education; *Drafting; *Geometric Constructions; High Schools; *Plane Geometry; Teaching Guides; Vocational Education
IDENTIFIERS	*Geometric Forms; Missouri

ABSTRACT

This Missouri Vocational Instruction Management System instructor's drafting guide has been keyed to the drafting competency profile developed by state industry and education professionals. The guide contains a cross-reference table of instructional materials. Three units cover related views and descriptive geometry: (1) auxiliary views and revolutions; (2) sectional views/conventions; and (3) descriptive geometry. Each unit contains the following: (1) unit and specific objectives; (2) suggested activities; (3) instructional materials; (4) unit content; (5) references; (6) instructor notes; (7) information sheets; (8) lessons; (9) transparency masters; (10) handouts; (11) assignment sheets; (12) job sheets; and (13) unit test and answers. (NLA)

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Module

4 RELATED VIEWS & DESCRIPTIVE GEOMETRY

70-4004-I
Instructor's Guide

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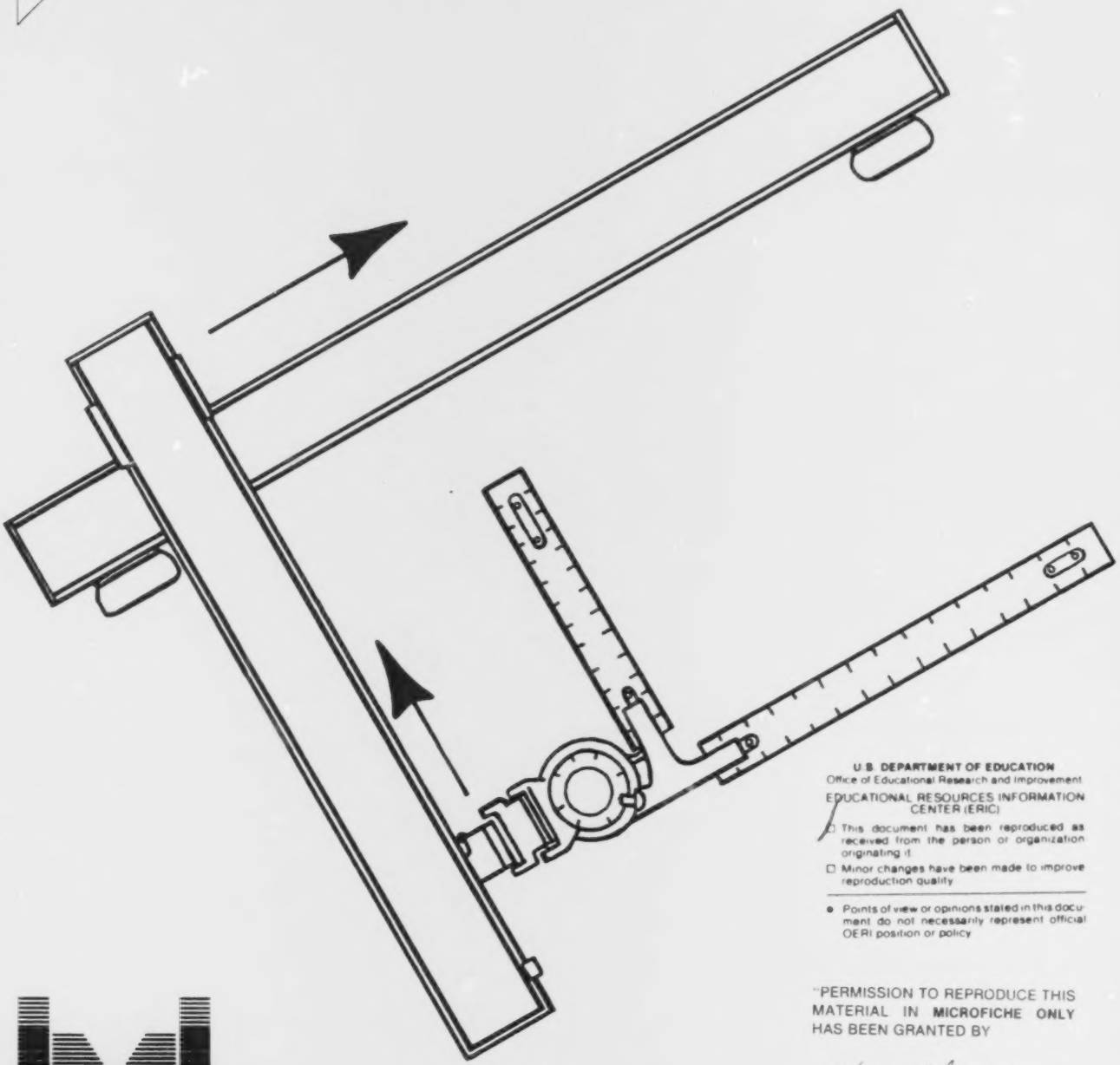

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Instructional Materials Laboratory, University of Missouri-Columbia, Columbia, Missouri

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DRAFTING

Module 4: Related Views and Descriptive Geometry

Instructional Materials Laboratory
8 London Hall
University of Missouri-Columbia
Columbia, MO 65211

1991

Instructor's Guide
Catalog N. 70-4004-I

FORWARD

Once again, we are indebted to the teachers and administrators who provided their time, effort and professionalism to develop curriculum guides for trade, technical and industrial education programs. This drafting guide is an outstanding example of what can be accomplished when the right people with the right attitude get together. Committee members worked hard over several years' time in advisory, writing, technical consultation and field-test capacities.

This guide is designed to be totally integrated with the Vocational Instructional Management System. It is hoped that all guides produced under our supervision will help classroom teachers manage instruction. A curriculum guide is more than a resource--it is an integral part of the management system. Rather than impeding instruction, it should guide and facilitate instruction.

This guide's format has been set up for competency-based teaching and testing. Unit tests evaluate specific competencies and can be used with the Vocational Administrative Management System (VAMS). Information sheets, transparency masters, job sheets, assignments sheets and test items are keyed to specific competencies. A cross-reference table has been included to identify quickly the parts of the curriculum that relate to specific competencies. The material has also been packaged for students.

Although this guide may be a new format for some teachers, we are confident that, when used as designed, time spent by teachers and students will become more productive. Any future drafting curriculum modifications will begin with this guide. The drafting field is undergoing constant and considerable change. We will annually evaluate the need to update this guide on a module-by-module basis. Your suggestions regarding ares for improvement are both encouraged and appreciated.

Judith Moore, supervisor
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Charles "Chuck" Waibel, director
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ACKNOWLEDGEMENTS

This drafting guide represents a continuing commitment to Missouri's Vocational Instructional Management System (VIMS). The guide has been keyed to the drafting competency profile developed by industry and education professionals in the state.

When searching for current drafting materials to adopt or use in the guide's development, comparable materials were found from the Mid-America Vocational Curriculum Consortium (MAVCC), of which Missouri is a member. MAVCC materials, therefore, have been relied upon as a resource for this guide. A debt of thanks is owed to the entire MAVCC organization for the research and development of these drafting materials.

Special appreciation is given to the writers for their self-motivation, reliability and technical expertise.

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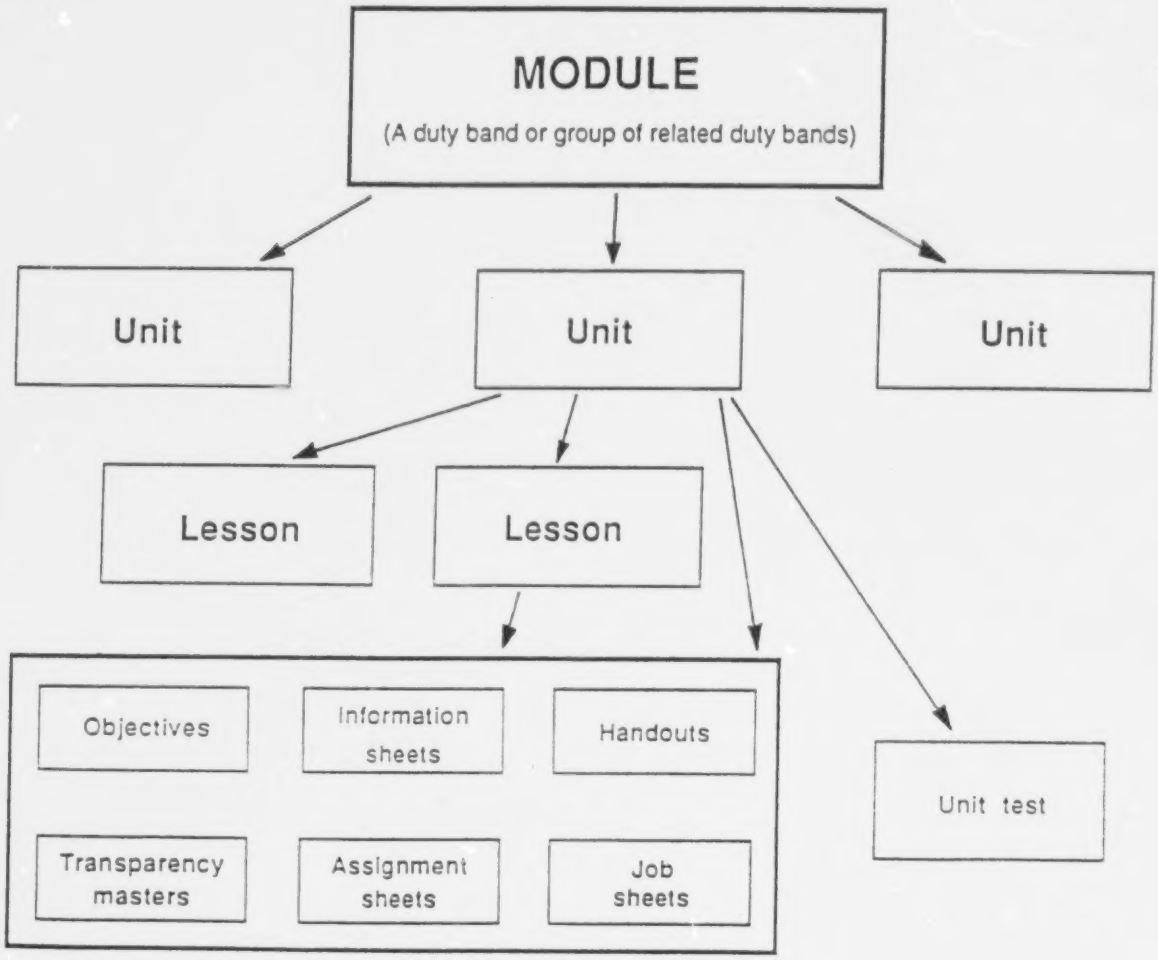
HOW TO USE THIS PUBLICATION

GUIDE COMPONENTS

Units of instruction

This Drafting guide contains ten modules of instruction. Within each module are instructional units including some or all of the following components: performance objectives, information sheets, transparency masters, handouts, assignment sheets, job sheets and a unit test. Special instructions on audiovisuals, supplies, etc., are included in the Notes to the Instructor section near the beginning of each unit.



Competency profile

On the Missouri competency profile, tasks are divided into general subject areas, or duty bands, which are identified by a capital letter. Under each duty band are related tasks (competencies), which are identified by an Arabic numeral. To evaluate the student on performance of the competencies, a 3-2-1-N grading system is used, where:

- **3 = Mastery** - can work independently with no supervision
- **2 = Requires supervision** - can perform job completely with limited supervision
- **1 = Not mastered** - requires instruction and close supervision
- **N = No exposure** - no experience or knowledge in this area

Cross-reference table (color-coded white)

Once the numbering system is understood, this table quickly reveals how the instructional components of the module relate to Missouri competencies. On the competency profile, tasks are divided into general subject areas, or duty bands, which are identified by a capital letter. Under each duty band are related tasks (competencies), which are identified by an Arabic numeral.

On the cross-reference table, unit numbers are represented by Roman numerals (I, II, III, etc.). Lessons within a unit are shown with Arabic numerals. Therefore, the first objective in Lesson 1 is numbered 1.1, the second is 1.2, etc. Other components of the module (transparencies, handouts, assignment sheets and job sheets) also use this numbering system. By looking at the cross-reference table, the instructor can quickly determine what test questions or job sheets a student needs to receive an evaluation on a particular competency.

Objectives (color-coded white)

Each unit is based on performance objectives that state the measurable unit and specific behavioral or performance objectives that students are expected to achieve. Since the objectives of the unit provide direction for the teaching-learning process, it is important for the teacher and students to have a common understanding of the objectives. Teachers should feel free to add/adapt objectives which will fit the material to student and community needs. Supporting material will, of course, need to be added for any new objectives.

Table of contents, references, notes to the instructor (color-coded pink)

These pages have been coded pink for instructor use only. The reference section lists materials used as sources in developing the material. Special instructions on audiovisuals, supplies, etc., are included in the Notes to the Instructor section.

Information sheets (color-coded green)

Presented in outline form for clarity, these pages provide content essential for meeting the cognitive (knowledge) objectives in the unit. Students should study the information sheets before class discussion or completion of assignment sheets. **CAUTION** statements indicate possible equipment damage, while **WARNING** statements recommend procedures to avoid bodily injury. Handouts and transparency masters are noted in the information sheets for instructional use.

Transparency masters (color-coded white)

Transparencies provide information by visually reinforcing or clarifying ideas presented in the information sheets. They are effective when identification is necessary, and they direct students to the topic of discussion. Transparencies should be left on the screen only when topics shown are under discussion.

Handouts (color-coded white)

Whenever more detailed information than can be presented in a transparency is needed, a handout is used. Handouts give the students additional information that can be kept with their class notes or student references.

Assignment sheets (color-coded tan)

Assignment sheets furnish paper-and-pencil practice to develop the knowledge necessary as a prerequisite to skill development. They can be given to students for class completion or used as homework assignments. Answer sheets (color-coded pink) can be used by the student or instructor to check progress.

Job sheets (color-coded blue)

These evaluation instruments are provided for two purposes: to outline steps of procedure and to check student performance mastery. Job sheets begin with a list of tools and materials needed for the activity. Job sheets furnish potential employers with a picture of skills being taught and performance that might be reasonably expected from a vocational student. The spaces to the right of the page on a job sheet assist the instructor in evaluating a student on a particular activity. This 3-2-1-N grading system is the same as the one used on the competency profile.

Unit test (color-coded yellow)

Competency-based tests are designed to help eliminate subjective testing and to improve student evaluation and accountability. Specific competencies and test questions are linked on the answer key. These unit tests have been written to be used with computerized VAMS (Vocational Administrative Management System), using Scantron sheets for computer-recording of test answers.

The unit test may be eliminated if the competency was thoroughly evaluated by job sheets. However, an emphasis should be placed on cognitive as well as performance skills. If the objective or competency will be evaluated by a job sheet, it is often necessary to determine by a written test whether the student understands enough of the material to perform the job sheet.

SUGGESTED ACTIVITIES

The following list of suggested activities may be helpful, especially to the beginning instructor.

1. Provide students with objective sheet and information sheets.
2. Discuss unit and specific objectives.
3. Discuss information sheets, assignment sheets and/or job sheets, lesson by lesson.
5. Give students unit test.
6. After successful completion of the test, have students do job sheet(s).

Students should perform the following activities.

1. Read objective sheet.
2. Study information sheets.
3. Do assignment sheet(s).
4. Take unit test.
5. Do job sheets.

Drafting

Module: Related Views and Descriptive Geometry

Cross-Reference Table of Instructional Materials

Competency	Unit	Instructional Objective	Transparency Master	Handout	Assignment Sheet	Job Sheet	Test Item	Notes
F-1	I	1.8	1-5	1-4	1,2,3,4,6			
F-2	I	1.8	8-10		7,8			
F-3	I	1.8	6,7	5	5			
F-4	I	1.1-1.7					1-35	
G-1	II	1.11	1-19	1-6	1-10			
G-2	II	1.3	11,13	7			24-27	
G-3	II	1.6	1,2,3,4,	1,2			1-10, 39	
G-4	II	1.8					52-55	
G-5	II	1.1-1.10	1-19	1-6			1-64	
I-1	III	1.1,1.2,1.4	1		9		1-17, 21	
I-2	III	1.1,1.2	1		1,3,6,9,10		1-17, 21	
I-3	III	1.1,1.2,1.4	1-4		2,4,5,7,8		1-17, 21	
I-4	III	1.1-1.4	1-4		11		1-21	
I-5	III	1.1,1.2,1.4	1-4		2,5,7,11		1-21	

MODULE: RELATED VIEWS AND DESCRIPTIVE GEOMETRY

UNIT I: AUXILIARY VIEWS AND REVOLUTIONS

UNIT OBJECTIVE

After completion of this unit, the student should be able to label points and surfaces; construct auxiliaries of lines, points, planes, and curved surfaces; determine true angle between planes; and determine shortest distance between lines. This knowledge will be evidenced by correctly performing the procedures outlined in the assignment sheets and by scoring ____ percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1.1 Match terms related to auxiliary views with their correct definitions.

1.2 Select true statements concerning uses of auxiliary views.

1.3 Name the views from which a primary auxiliary can be projected.

1.4 Select true statements concerning projection of measurements in a primary auxiliary view.

1.5 List the different locations of a reference line.

1.6 Select true statements concerning projection of measurements in a secondary auxiliary view.

1.7 Select true statements concerning characteristics of rotation.

1.8 Demonstrate the ability to:

- a. Label points and planes of a three-view object.
- b. Construct a primary auxiliary of an inclined plane.
- c. Construct a true-size auxiliary of a curved surface.
- d. Construct true length of an oblique line.
- e. Construct a secondary auxiliary view of an object.
- f. Construct point view of a line.
- g. Construct true lengths of lines by rotation.
- h. Construct true sizes of planes by rotation

MODULE: RELATED VIEWS AND DESCRIPTIVE GEOMETRY

UNIT I: AUXILIARY VIEWS AND REVOLUTIONS

CONTENTS OF THIS UNIT

A. Objective sheet

B. References

C. Notes to the instructor

D. Lesson plans

1. Lesson 1: PRIMARY AND SECONDARY AUXILIARY VIEWS

a. Information outline

b. Transparency masters

TM 1.1: Primary Auxiliary
TM 1.2: Primary Auxiliary (Continued)
TM 1.3: Auxiliary View Projection
TM 1.4: Need for Auxiliary View
TM 1.5: Possible Reference Plane Locations
TM 1.6: Secondary Auxiliary View
TM 1.7: Secondary Auxiliary View (continued)
TM 1.8: Rotation of a Point
TM 1.9: True Lengths by Rotation
TM 1.10:True Sizes by Rotation

c. Handouts

HO 1.1: Primary Auxiliary
HO 1.2: Auxiliary View Projection
HO 1.3: Need for Auxiliary View
HO 1.4: Possible Reference Plane Locations
HO 1.5: Secondary Auxiliary View
HO 1.6: Rotation of a Point
HO 1.7: True Length by Rotation
HO 1.8: True Size by Rotation

d. Assignment sheets

AS 1.1: Label Points and Planes of a Three View Object
AS 1.2: Construct a Primary Auxiliary of an Inclined Plane
AS 1.3: Construct a True Size Auxiliary of a Curved Surface
AS 1.4: Construct True Length of an Oblique Line
AS 1.5: Construct a Secondary Auxiliary View of an Object
AS 1.6: Construct Point View of a Line
AS 1.7: Construct True Lengths of Lines by Rotation
AS 1.8: Construct True Sizes of Planes by Rotation

E. Answers to assignment sheets

F. Unit test

G. Answers to unit test

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NOTES TO THE INSTRUCTOR

A. Suggested approaches to teaching this unit.

1. Construct a "Glass Box Model" to demonstrate auxiliary projection.

2. Bring in other blocks or objects.

3. Explain the use and need for auxiliary views.

MODULE: RELATED VIEWS AND DESCRIPTIVE GEOMETRY

UNIT I: AUXILIARY VIEWS AND REVOLUTIONS

LESSON 1: PRIMARY AND SECONDARY AUXILIARY VIEWS

I. Terms and definitions

A. **Auxiliary view**--a view or surface that is not perpendicular or right angle to the plane of projection

B. **Edge view**--a line representing the inclined plane

C. **Fold line**--a theoretical line between two views where viewing planes fold

D. **Foreshortened**--to appear shorter to the eye than it actually is

E. **Grade**--the degree of inclination of a slope

F. **Inclined plane**--a plane that is foreshortened in two principal viewing planes and edge view in one other principal viewing plane

G. **Line of sight**--direction from which an object is being viewed

H. **Oblique plane**--a plane that is foreshortened in all three principal viewing planes

I. **Partial auxiliary**--shows only the true size and detail of the inclined plane

NOTE: Hidden lines are omitted.

J. **Perpendicular line**--a line at 90° to a given plane of projection

K. **Primary auxiliary view**--a first projection of an inclined plane from one of the principal views

L. **Reference line**--a common line on back side, center, front side, or between views from which depth measurements are taken

M. **Rotation**--a method of projection in which the observer stays stationary and the object is rotated for different views of the object

N. **Secondary auxiliary view**--oblique plane or line projected from a primary auxiliary view and one of the principal views

O. **Skew lines**--nonintersecting lines, not parallel to each other or to the principal views

P. **Slope**--the angle a line makes with the horizontal plane

Q. **Symmetrical**--has same shape and size on opposite sides of a center line

R. **Transfer**--take from one point or view and put in another view

S. **True size**--a surface that is shown in its actual size

NOTE: This is based upon the scale used.

T. **True length line**--a line that appears in its actual length

U. **True angle**--an angle formed by two intersecting planes

NOTE: This is often referred to as a dihedral angle.

II. Uses of auxiliary views

A. Determine clearance distances and angles between manufactured parts

B. Describe inclined surfaces of manufactured parts

C. Determine true length of structural members

III. Views from which a primary auxiliary can be projected--All six views

IV. Projection of measurements in a primary auxiliary view (TM 1, 2, 3 and 4) (HO 1.1-1.3)

A. Depth and height measurements are transferred with a scale or dividers in their true length from one of five views

B. Measurements cannot be made from view with edge view

C. Length measurements are projected in their true length perpendicular from edge view to primary auxiliary

V. Different locations of a reference line (TM 1.5) (HO 1.4)

A. Back edge of view

B. Center line

C. Front edge of view

D. Between views

NOTE: These are referred to as fold lines.

VI. Projection of measurements in a secondary auxiliary view

A. Depth measurements are transferred from the edge view of one of the principal views

B. Length measurements are projected from primary auxiliary view

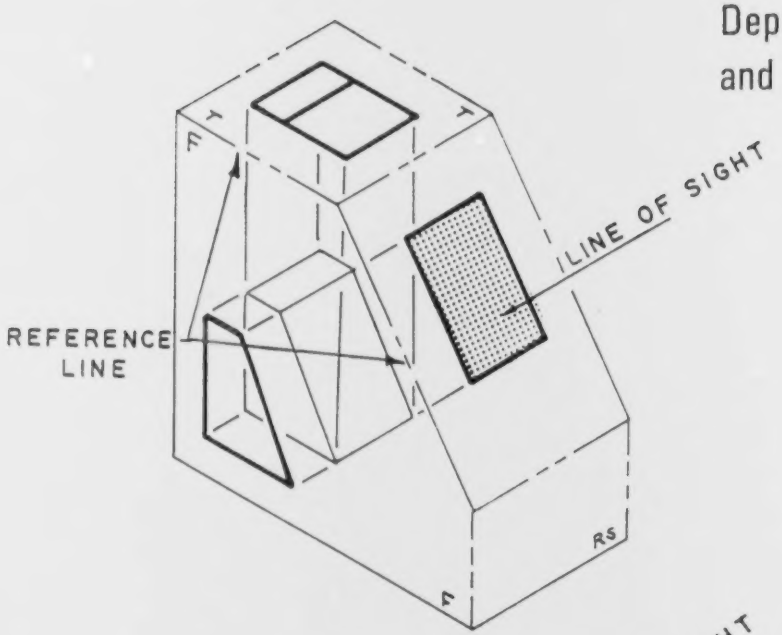
VII. Rotated views

A. Object is rotated; observer stays stationary

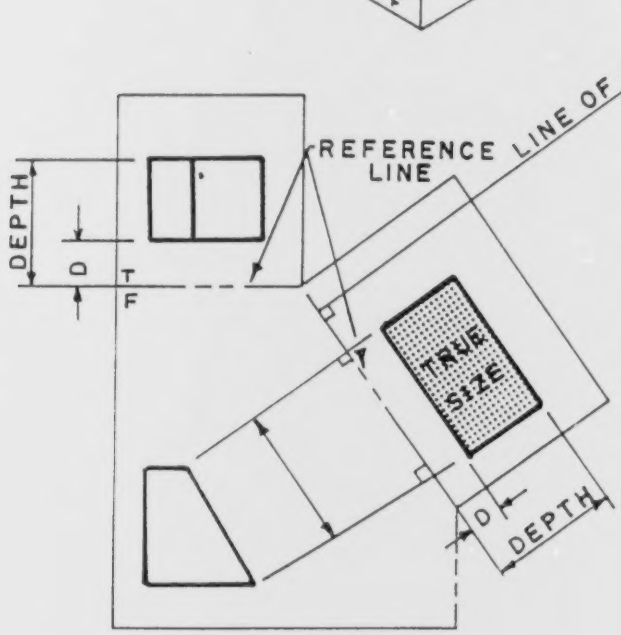
B. Eliminates some of the auxiliary views previously needed

Primary Auxiliary

Depth Equal in Top and Auxiliary Views

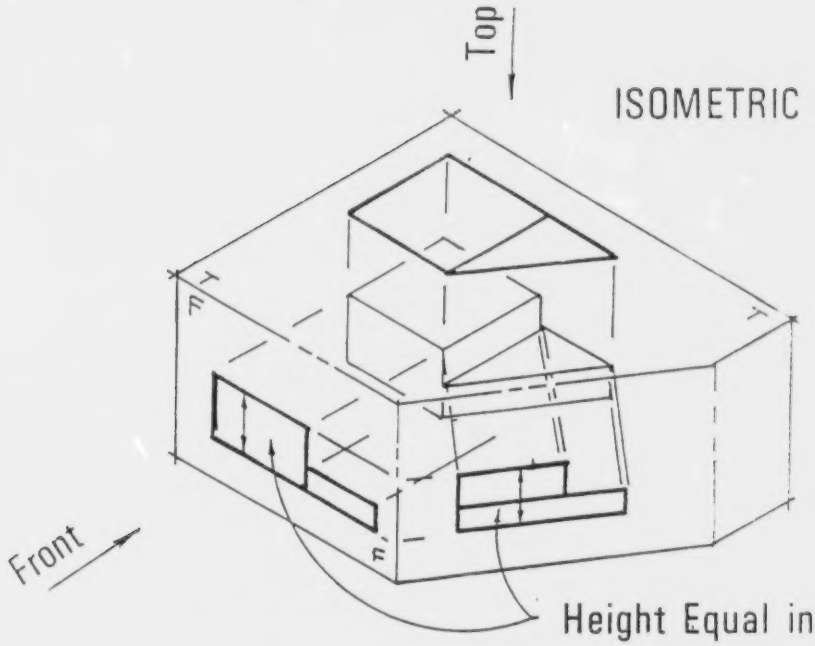


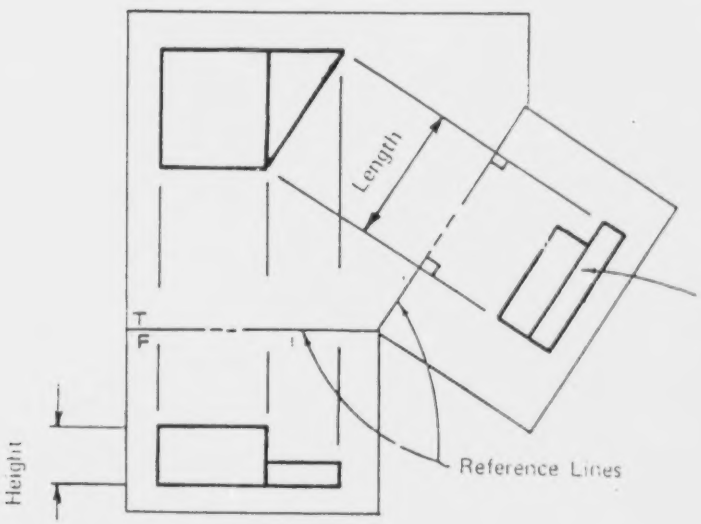
ISOMETRIC VIEWS



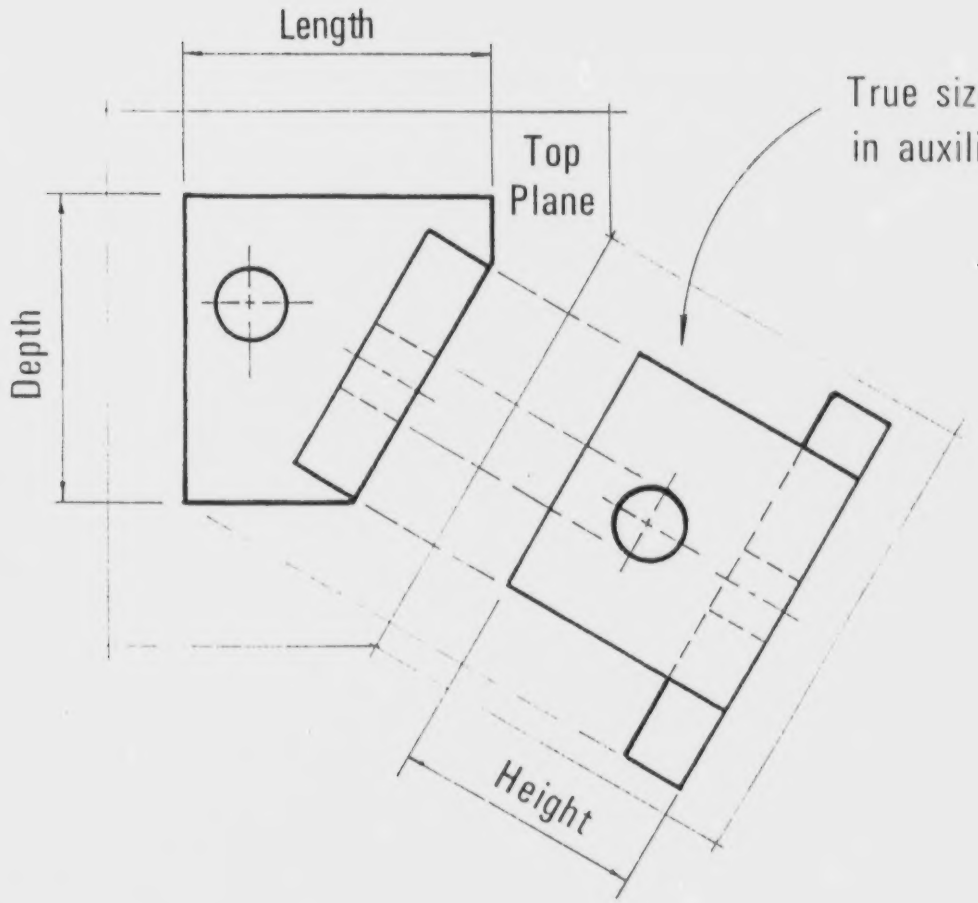
ORTHOGRAPHIC VIEWS

Primary Auxiliary (Continued)

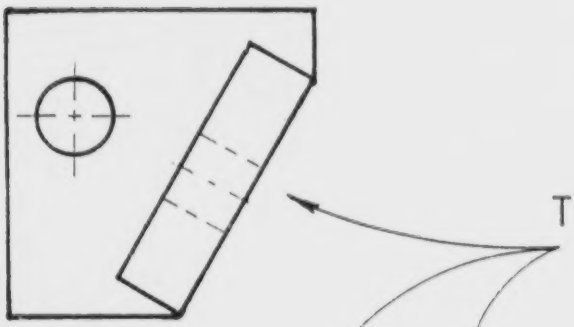




Auxiliary View Projection

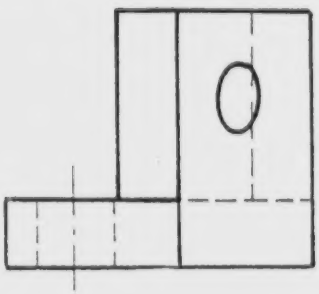


Need for Auxiliary View

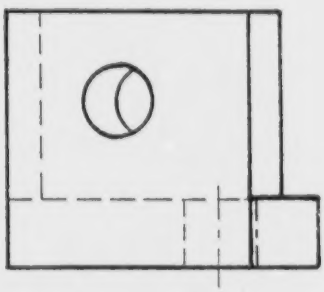


Top

True size and shape of surface not shown in any regular view.

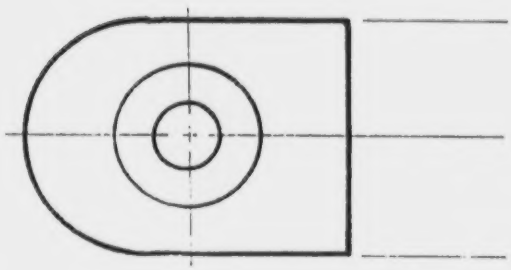


Front



Right Side

Possible Reference Plane Locations



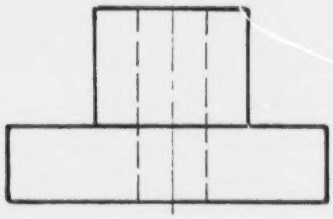
Back Side

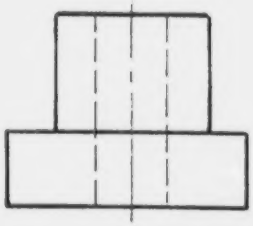
Middle

Front Side

Fold Line

Between Object

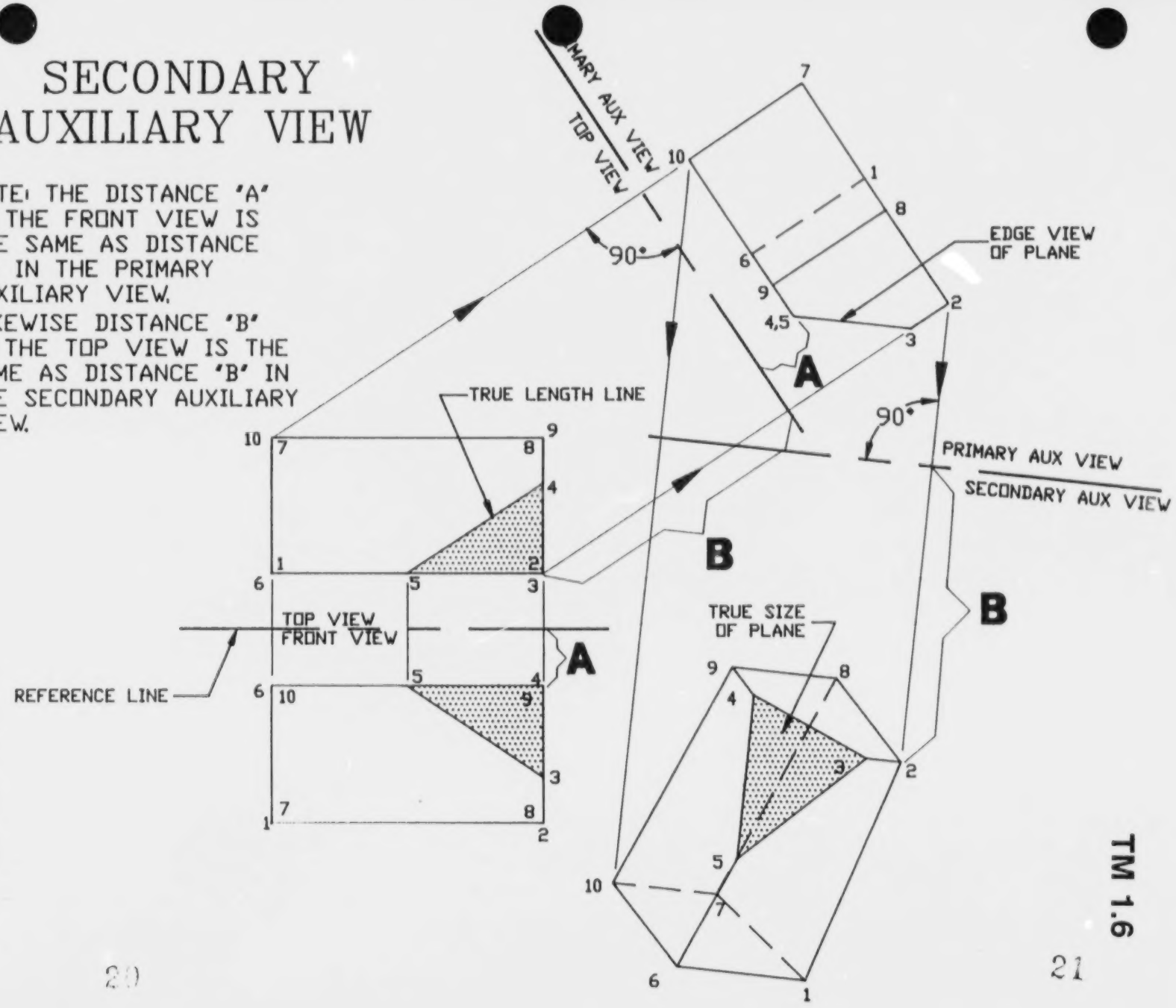




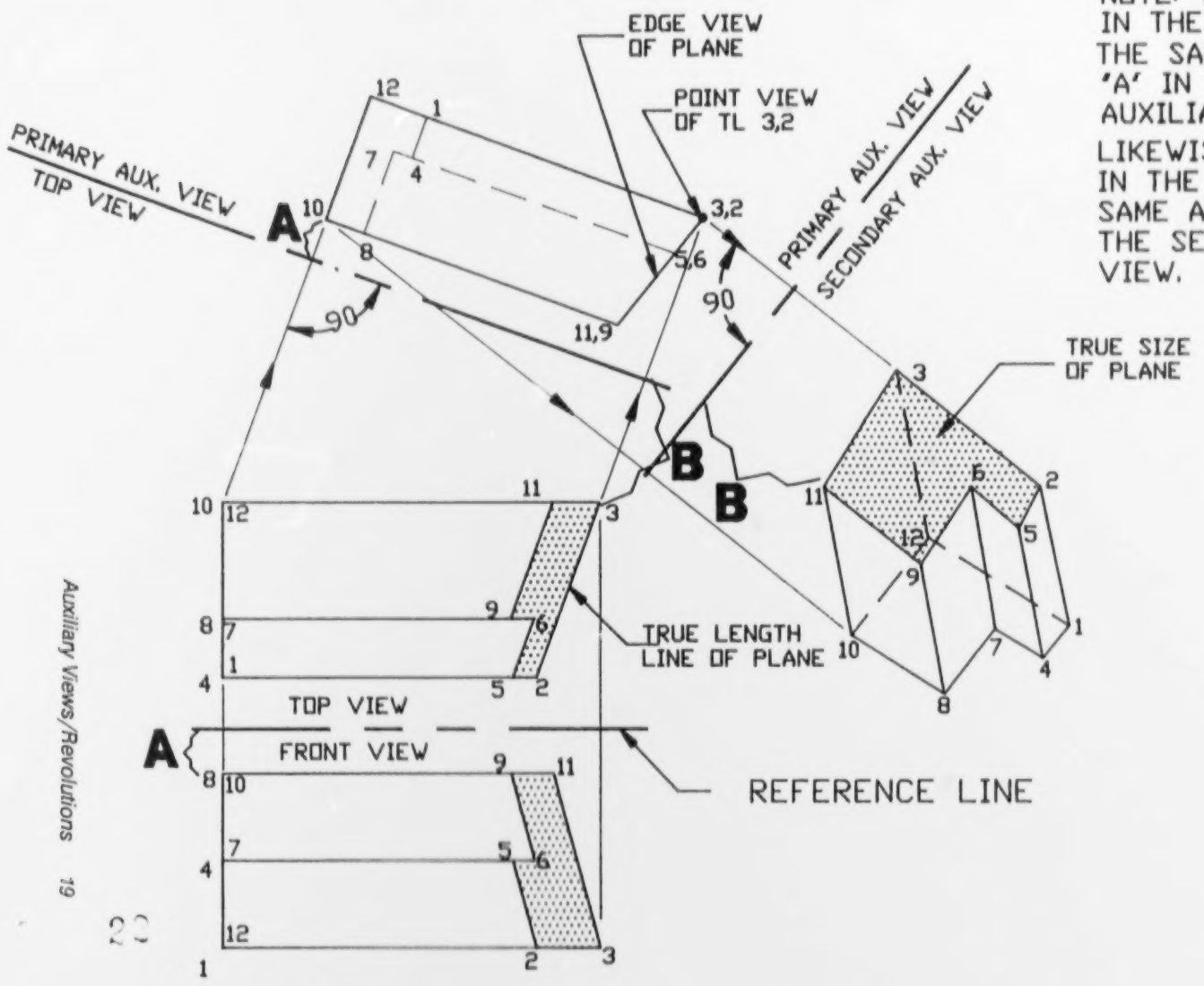
SECONDARY AUXILIARY VIEW

NOTE: THE DISTANCE 'A' IN THE FRONT VIEW IS THE SAME AS DISTANCE 'A' IN THE PRIMARY AUXILIARY VIEW.

LIKEWISE DISTANCE 'B' IN THE TOP VIEW IS THE SAME AS DISTANCE 'B' IN THE SECONDARY AUXILIARY VIEW.



SECONDARY AUXILIARY VIEW



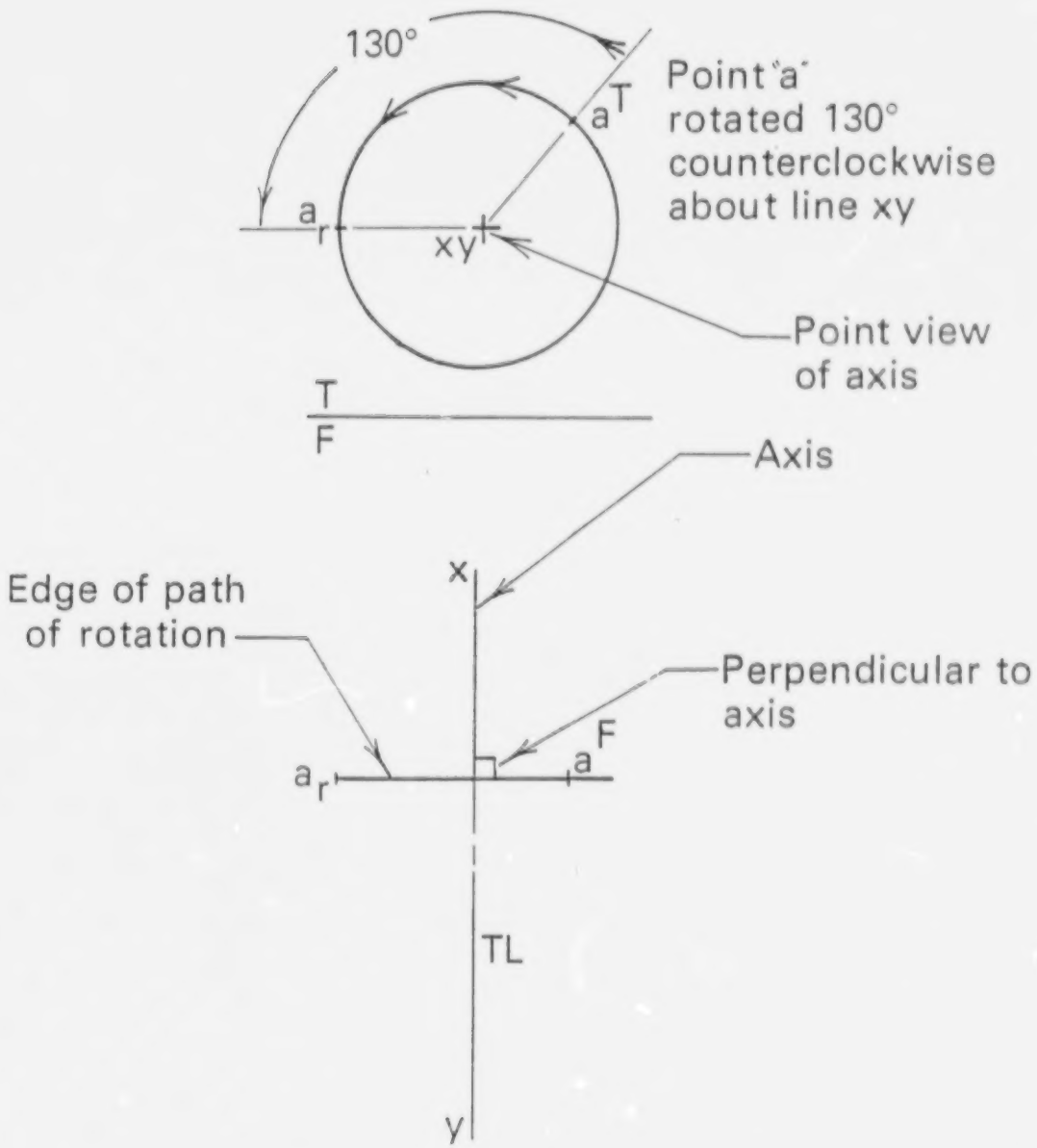
NOTE: THE DISTANCE 'A' IN THE FRONT VIEW IS THE SAME AS DISTANCE 'A' IN THE PRIMARY AUXILIARY VIEW.

LIKEWISE DIATANCE 'B' IN THE TOP VIEW IS THE SAME AS DISTANCE 'B' IN THE SECONDARY AUXILIARY VIEW.

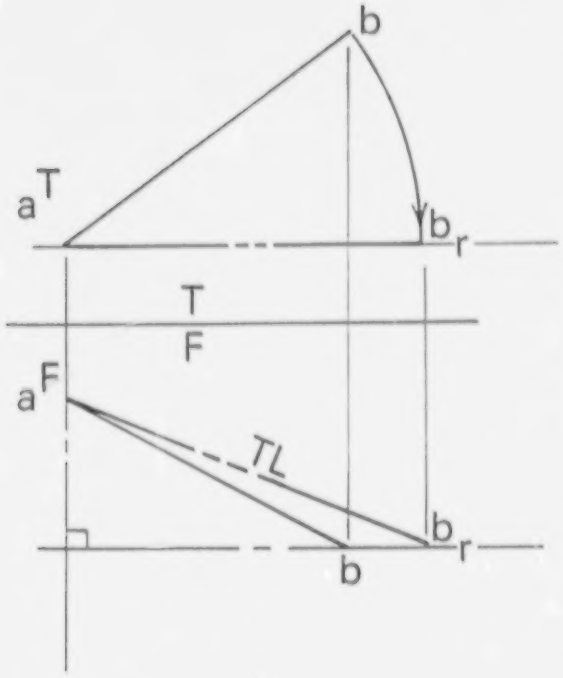
Auxiliary Views/Revolutions 19

TM 1.7

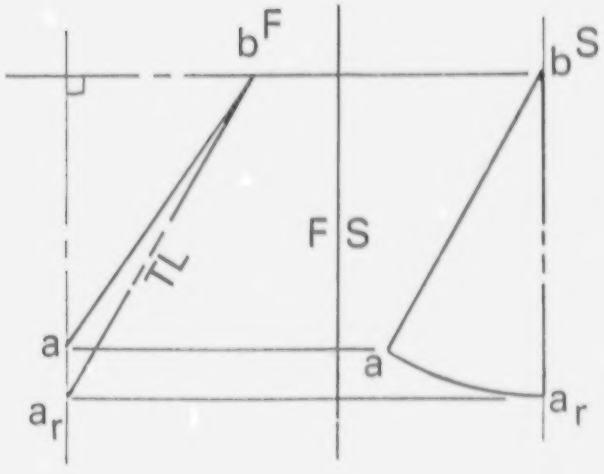
Rotation of a Point



True Lengths by Rotation

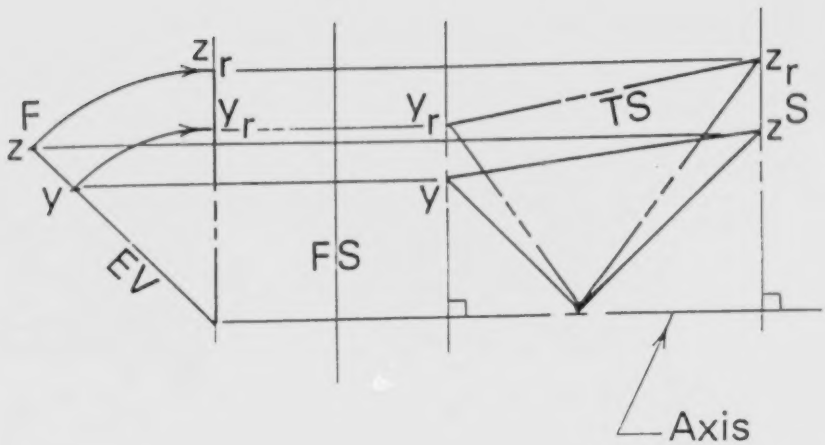


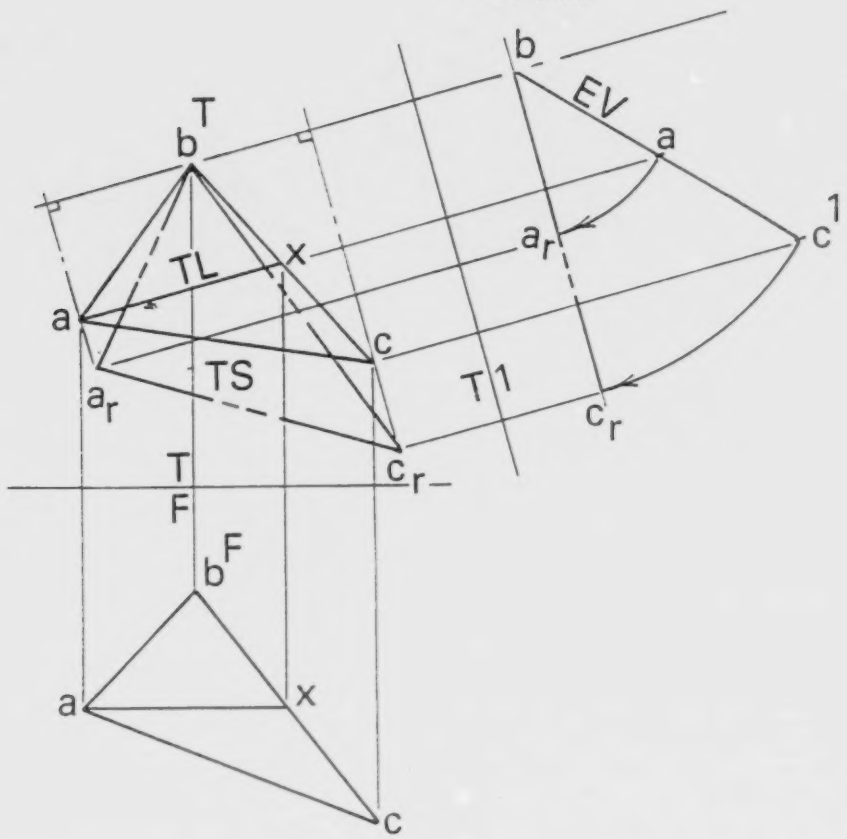
(a)



(b)

True Sizes By Rotation

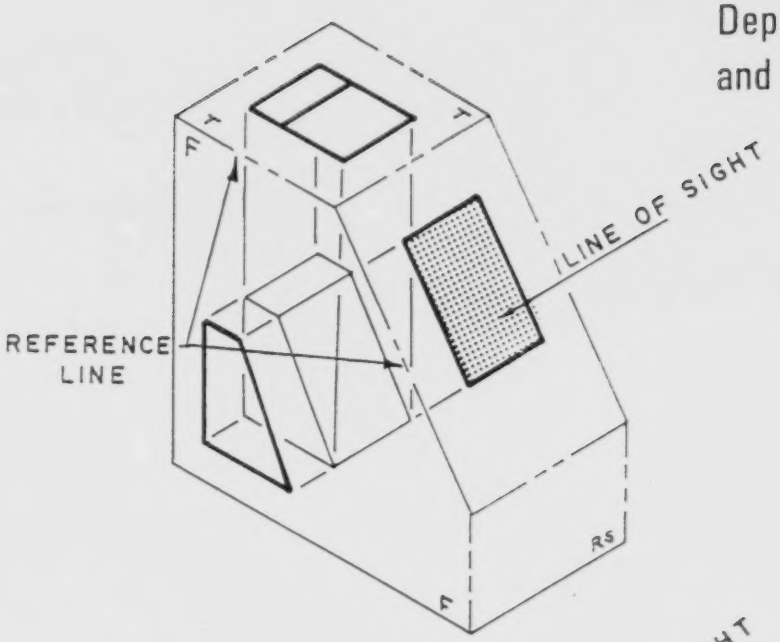




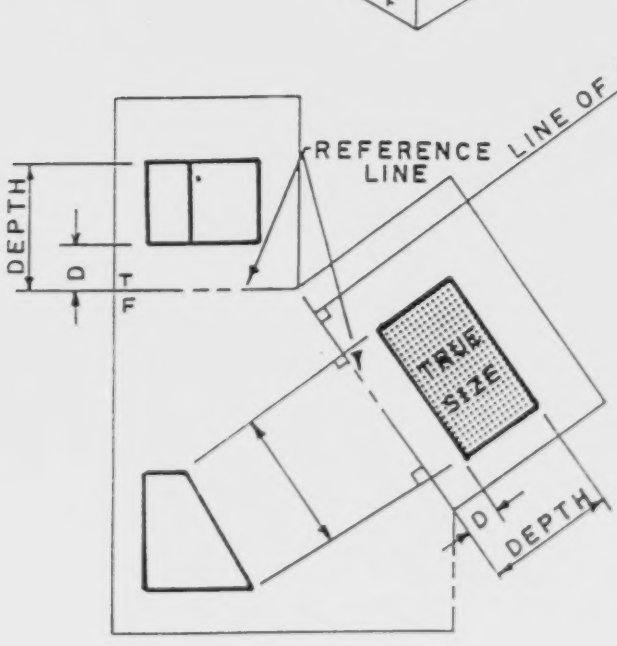
HO 1.1

Primary Auxiliary

Depth Equal in Top and Auxiliary Views

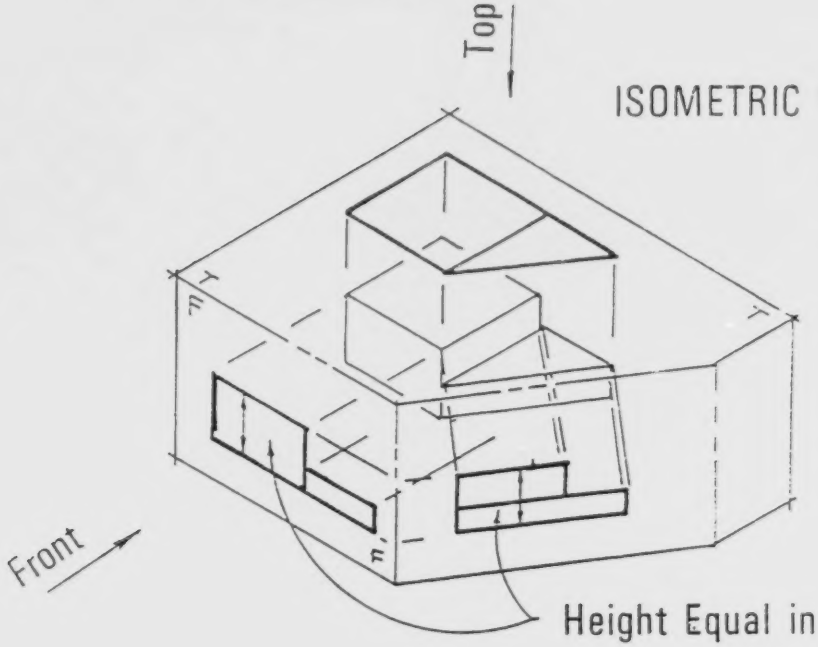


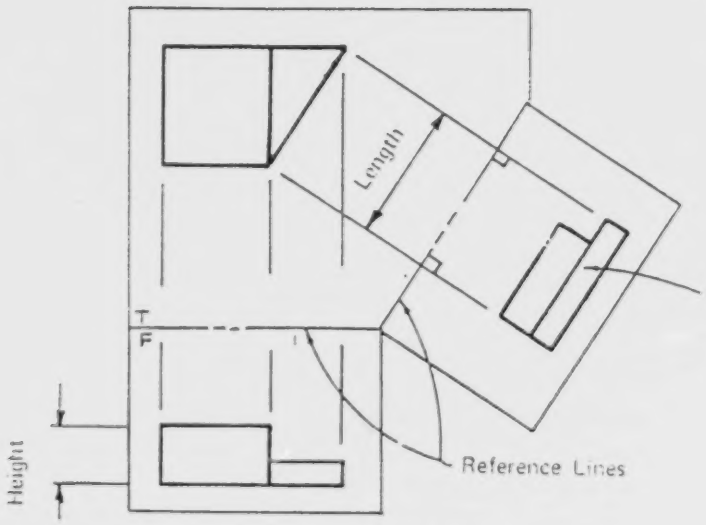
ISOMETRIC VIEWS



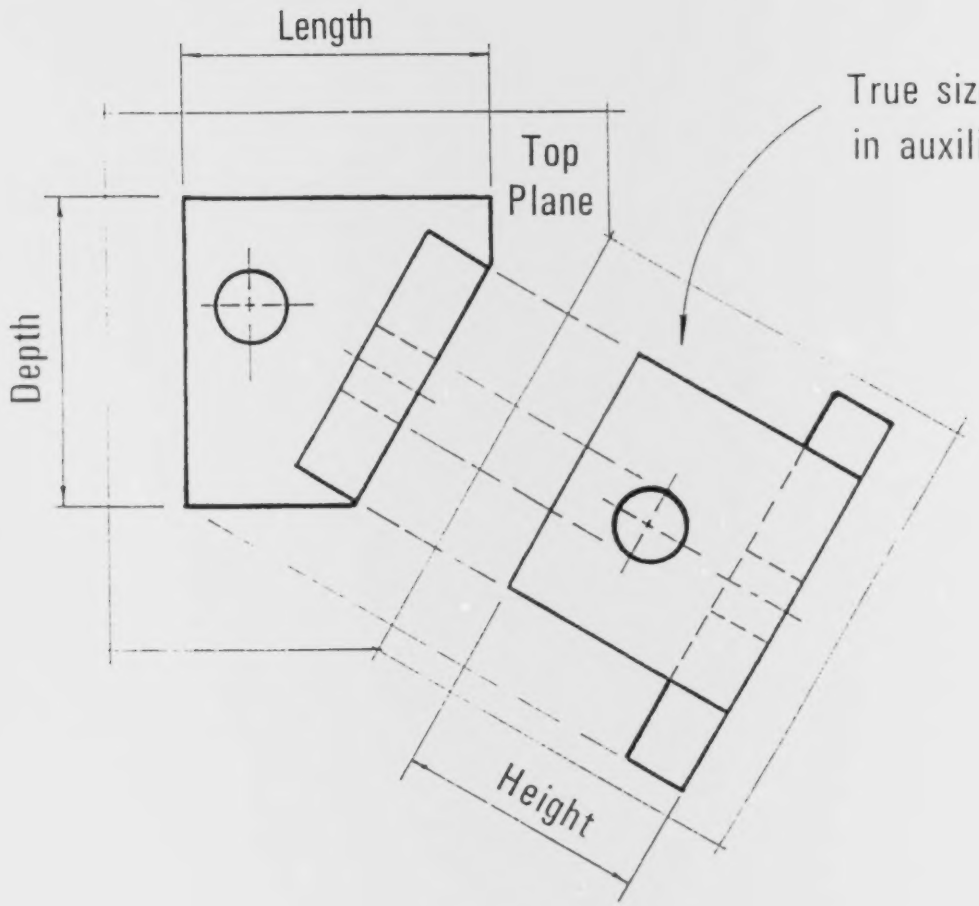
ORTHOGRAPHIC VIEWS

Primary Auxiliary (Continued)

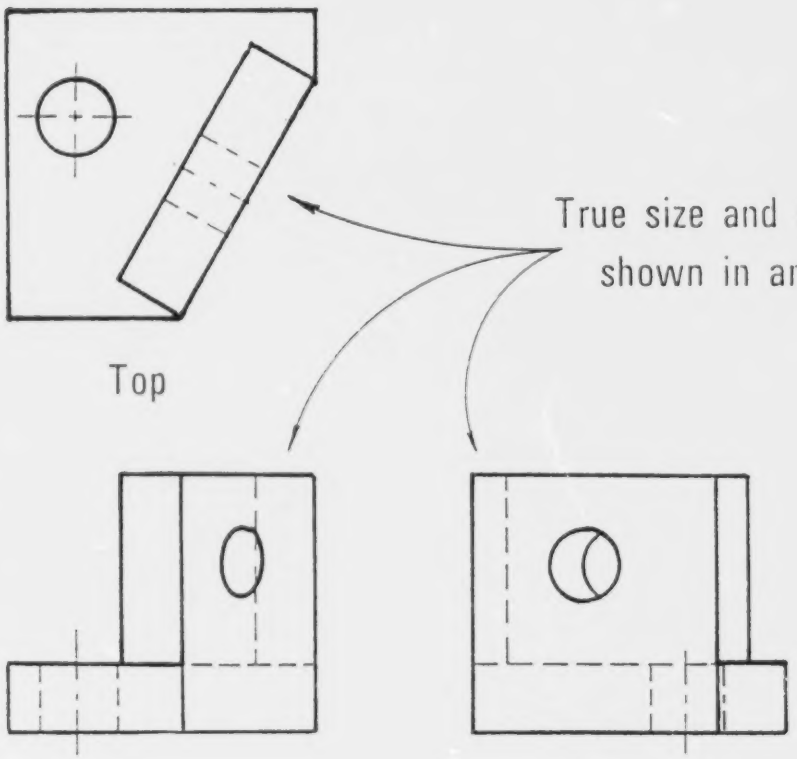




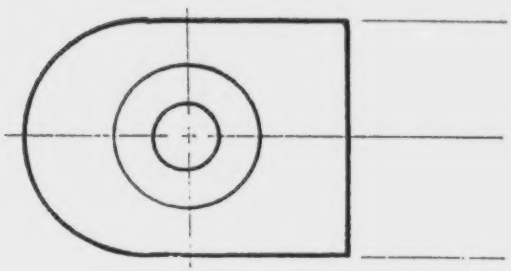
Auxiliary View Projection



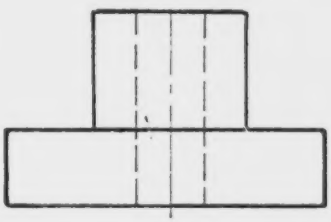
Need for Auxiliary View

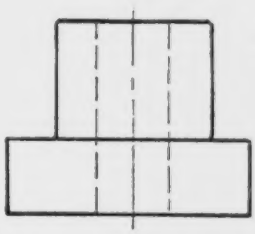


Possible Reference Plane Locations



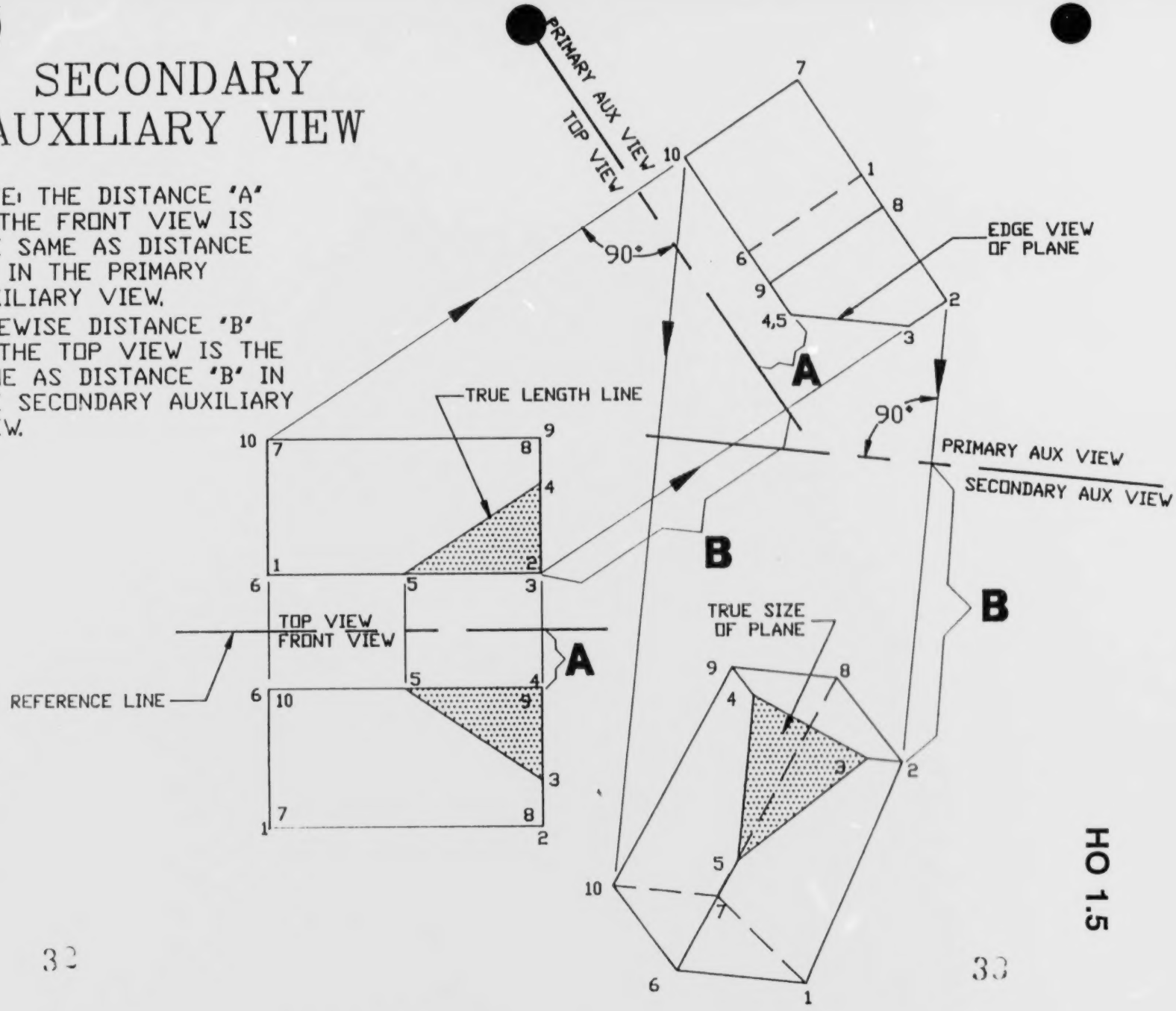
Fold Line _____ _ _ _____ Between Object





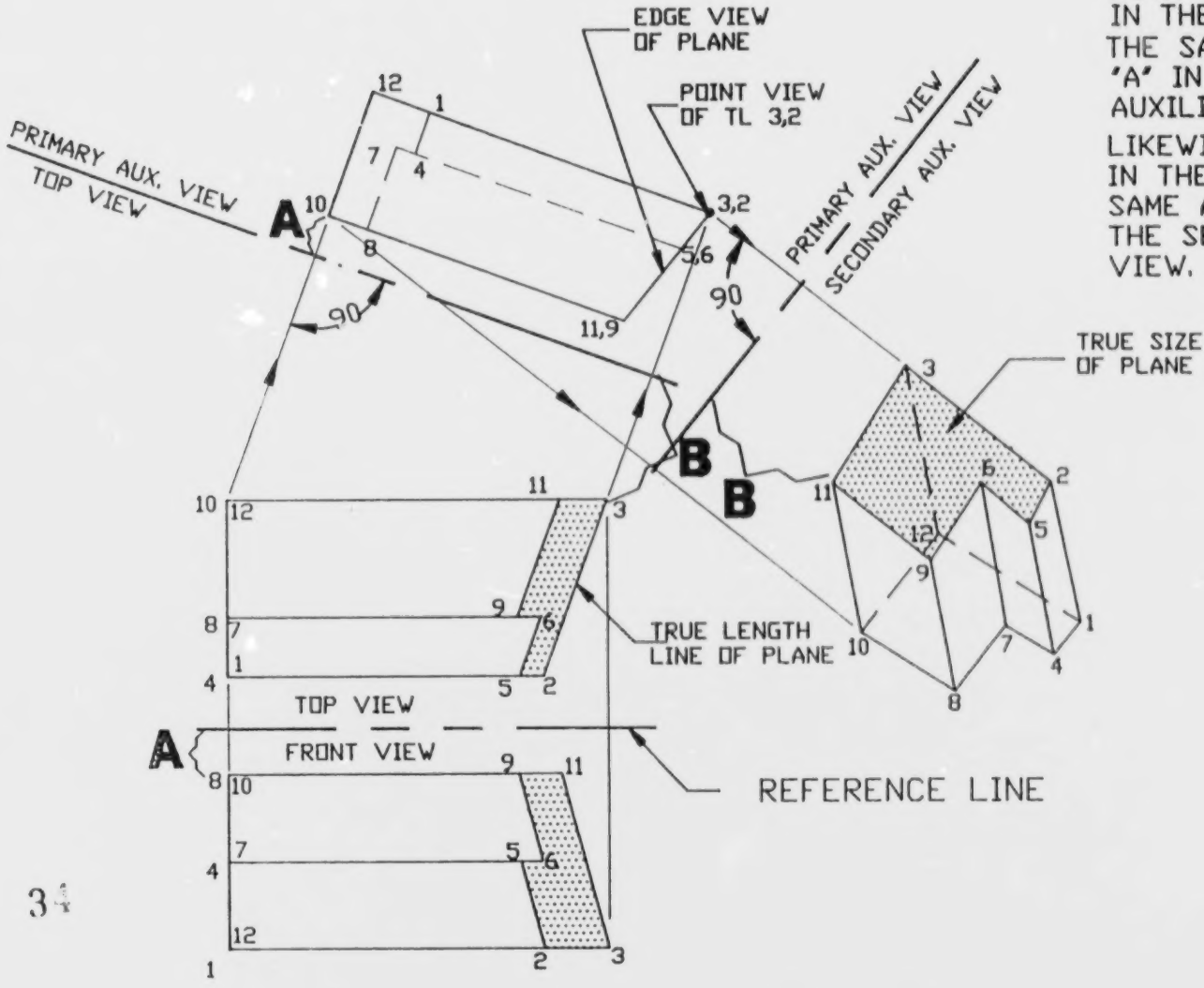
SECONDARY AUXILIARY VIEW

NOTE: THE DISTANCE 'A' IN THE FRONT VIEW IS THE SAME AS DISTANCE 'A' IN THE PRIMARY AUXILIARY VIEW.
LIKEWISE DISTANCE 'B' IN THE TOP VIEW IS THE SAME AS DISTANCE 'B' IN THE SECONDARY AUXILIARY VIEW.



HO 1.5

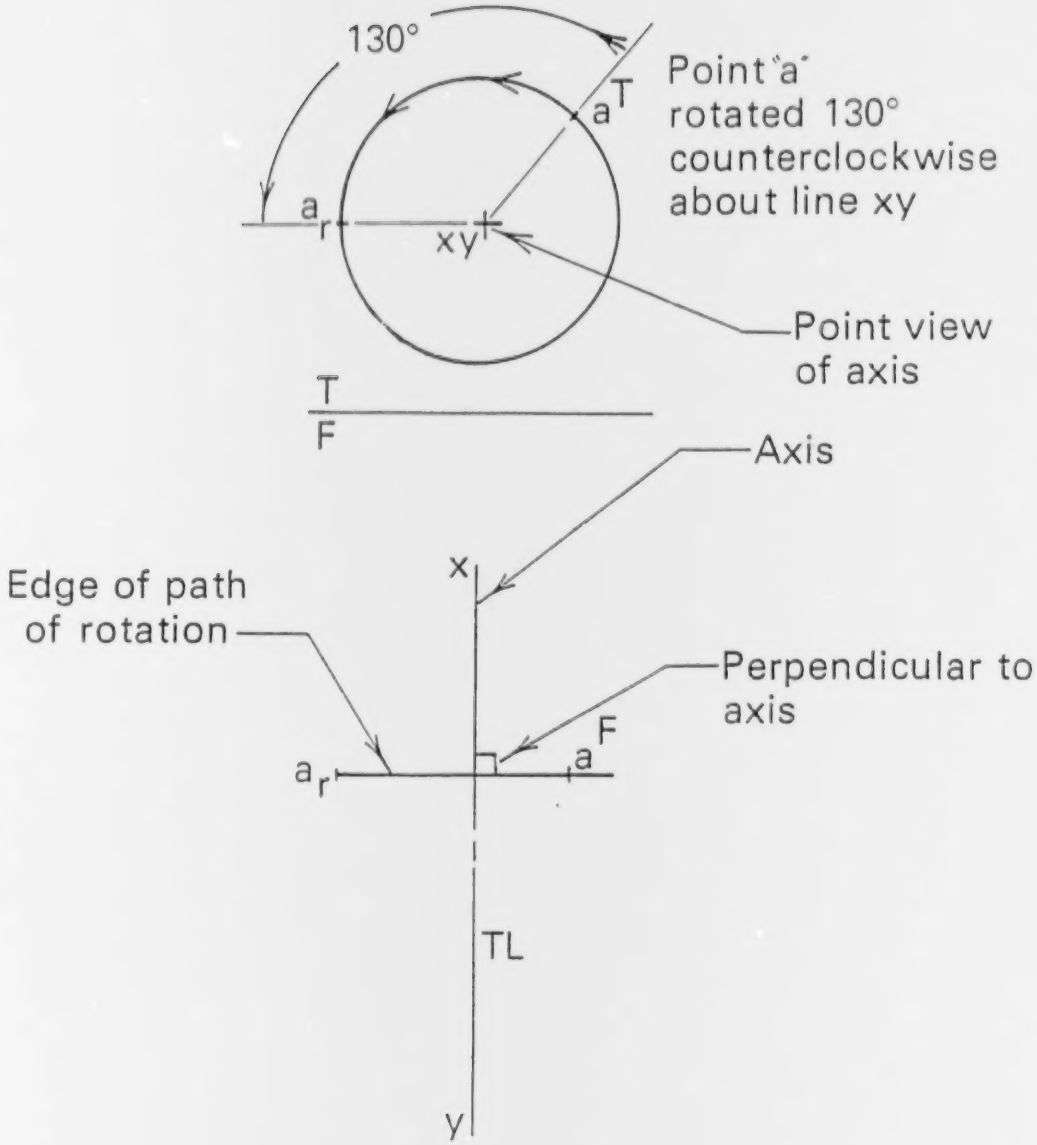
SECONDARY AUXILIARY VIEW



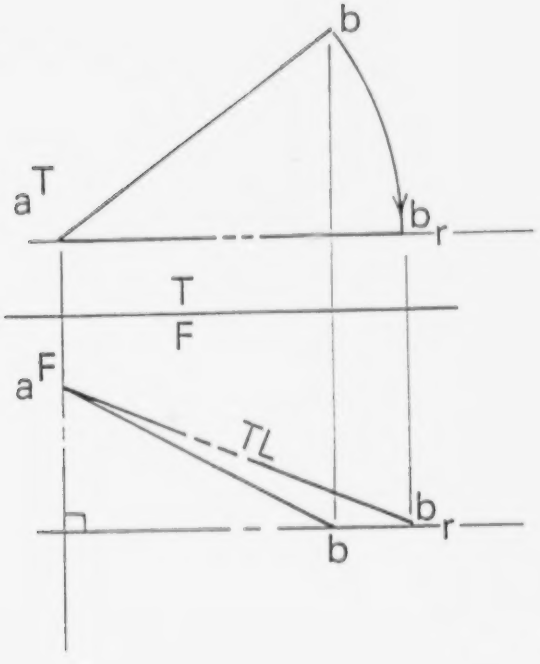
NOTE: THE DISTANCE 'A' IN THE FRONT VIEW IS THE SAME AS DISTANCE 'A' IN THE PRIMARY AUXILIARY VIEW.

LIKEWISE DIATANCE 'B' IN THE TOP VIEW IS THE SAME AS DISTANCE 'B' IN THE SECONDARY AUXILIARY VIEW.

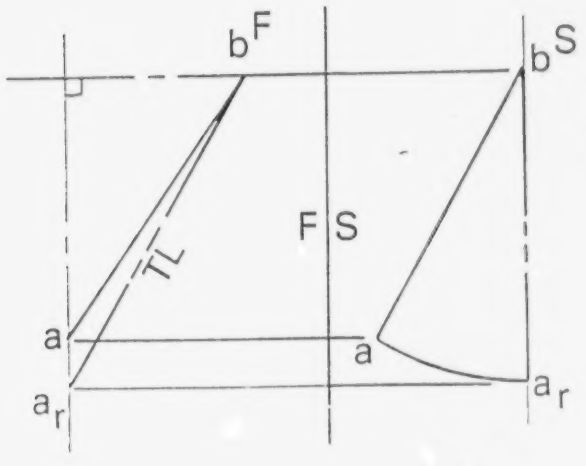
Rotation of a Point



True Lengths by Rotation

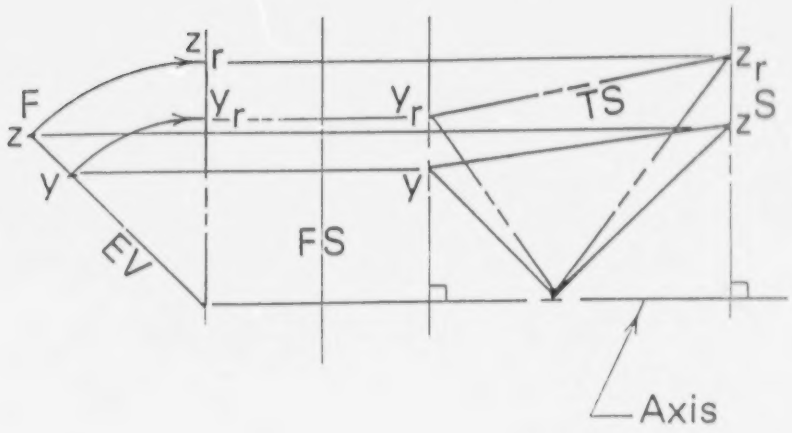


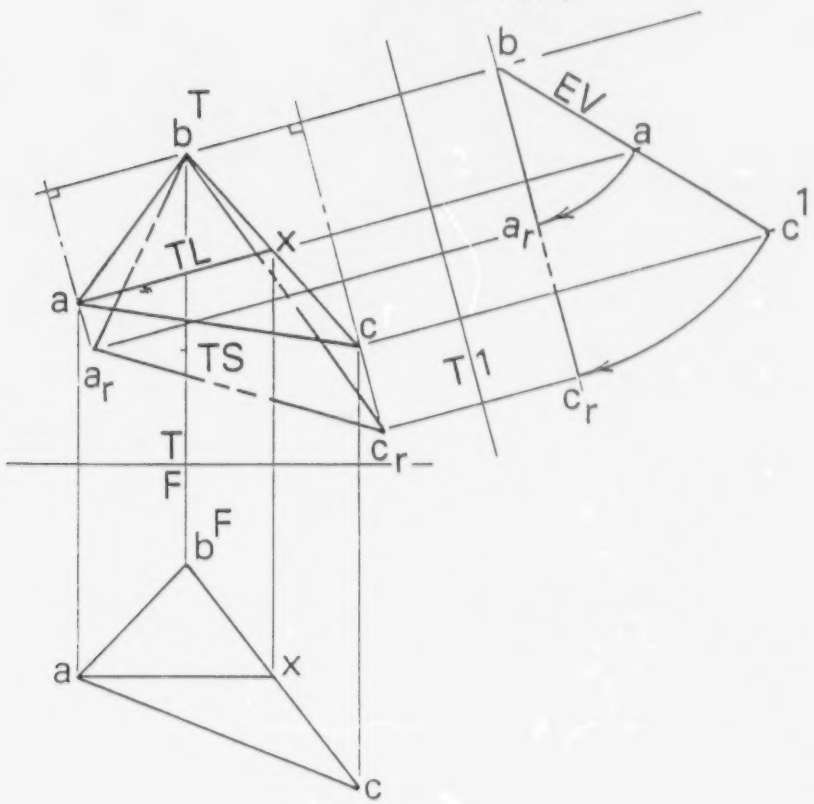
(a)



(b)

True Sizes By Rotation





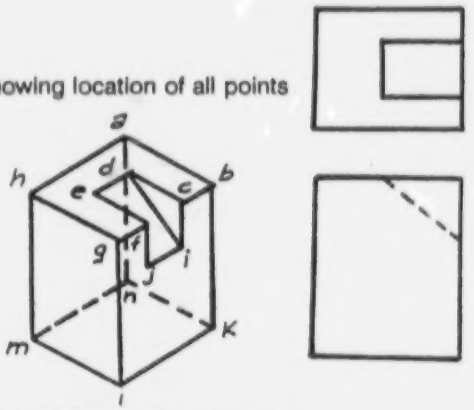
LABEL POINTS AND PLANES

OF A THREE VIEW OBJECT

Premise: When two planes meet, they form a line; when two lines meet, they form a point. An object is made of lines, points, and planes. In drawing auxiliary views of an object, it becomes necessary to label these lines, points, and planes with letters or numbers to be absolutely sure that the auxiliary views are formed correctly. Labeling points is not used in all of auxiliary view drawing, but it is beneficial on hard-to-visualize objects. Points and planes of a three view object can be labeled by using the procedure in the following example.

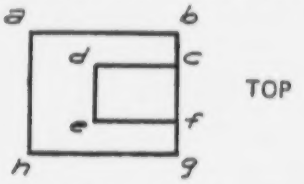
Example:

1. Use given two views of an object with a pictorial showing location of all points

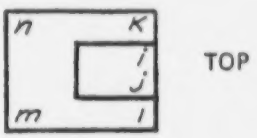


2. Start with top view and label all points that make up the corners of the top plane

   NOTE: Use lower case letters; if two corners are on the same point, put the letter outside the object to indicate point closest to observer.



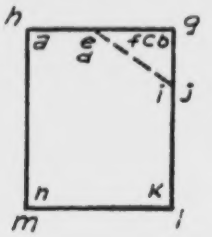
3. Label points that are away from observer by putting their point callout letters inside the object



BEST COPY AVAILABLE

4. Use same procedure to locate point letter callouts in front view

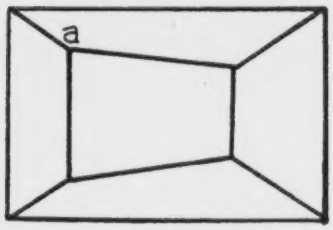
NOTE: Points closest go outside the object; those behind go inside the object.

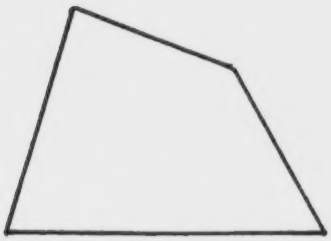


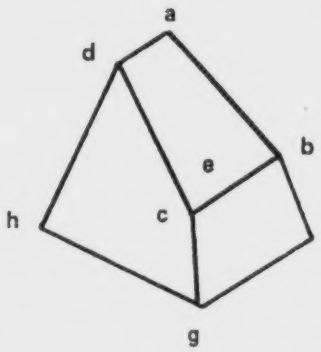
FRONT

Directions: Label points of the object below using lower case letters. Start at point a.

Problem:







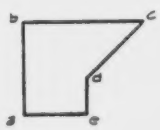
CONSTRUCT A PRIMARY AUXILIARY

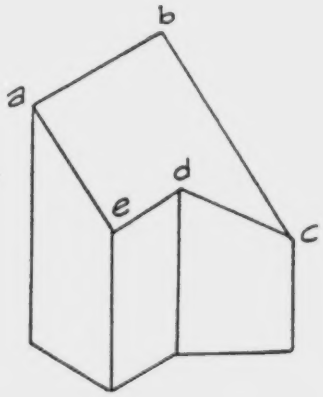
OF AN INCLINED PLANE

Premise: Many objects have a plane that is inclined; if this plane needs to be dimensioned, it will be necessary to draw it true size. A primary auxiliary of an inclined plane can be constructed by using the procedure in the following example.

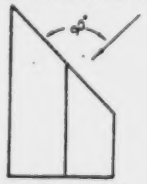
Example:

1. Use given top and front view; draw auxiliary view of plane abcde



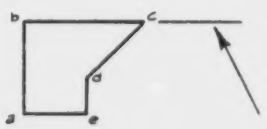


2. Determine line of sight perpendicular to edge view of plane abcde to be drawn to true size



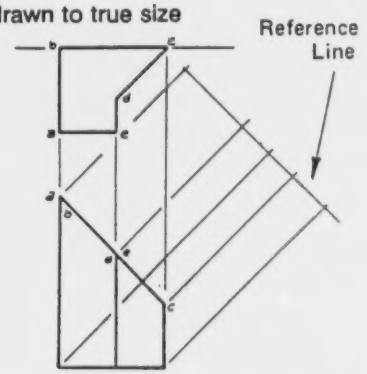
3. Locate reference line in the top view in either of the following places: back, middle, front, or between views

   NOTE: The back of the top view was used for this example.



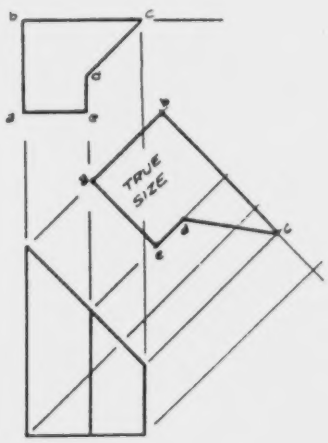
4. Locate reference line in auxiliary view perpendicular to line of sight at an adequate distance from edge of front view

5. Draw light projection lines from points of plane to be drawn to true size



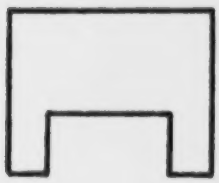
6. Locate points on or in relation to reference plane by transferring measurements from top view with dividers

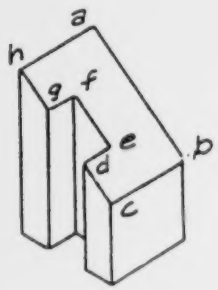
7. Connect points in auxiliary view that appear to be connected in top view; darken lines

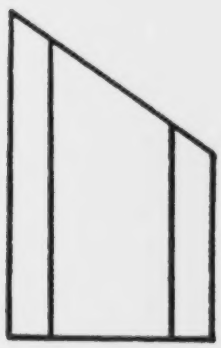


Directions: Label points and draw an auxiliary view of the inclined planes. Leave all construction lines.

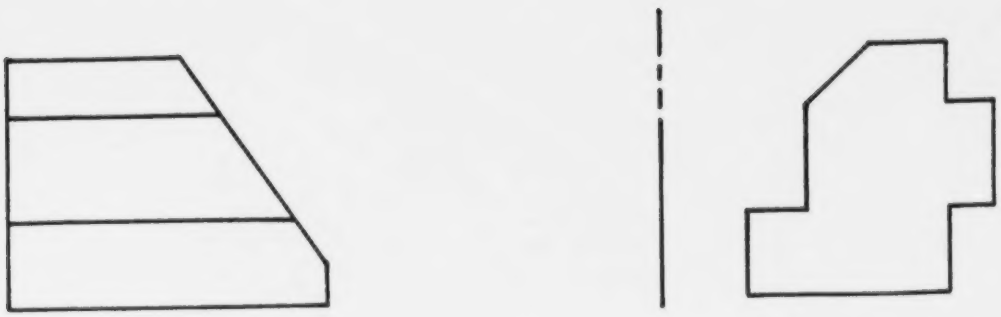
Problem A:







Problem B:



Problem C:

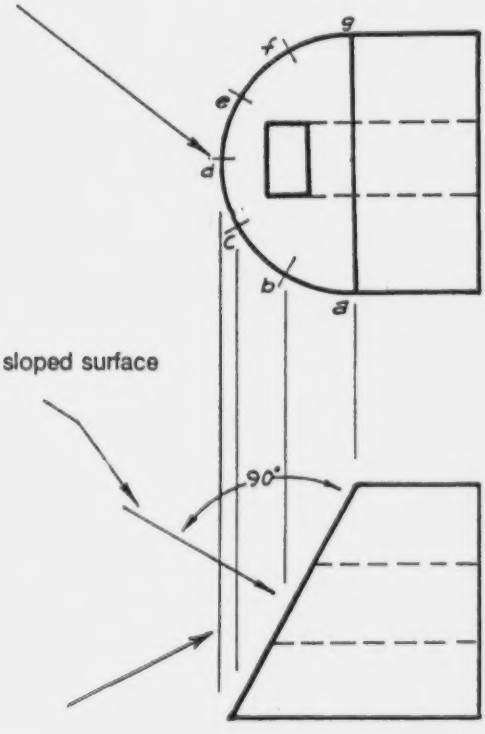
CONSTRUCT A TRUE SIZE AUXILIARY

OF A CURVED SURFACE

Premise: A curved surface such as a circle is divided up into a series of points, and points are used to plot the true size of the curved surface. A true size auxiliary of a curved surface can be constructed by using the procedure in the following example.

Example:

1. Given an object that has a surface in front view that is cut at an angle, divide the top view up into a series of points and number or letter each point

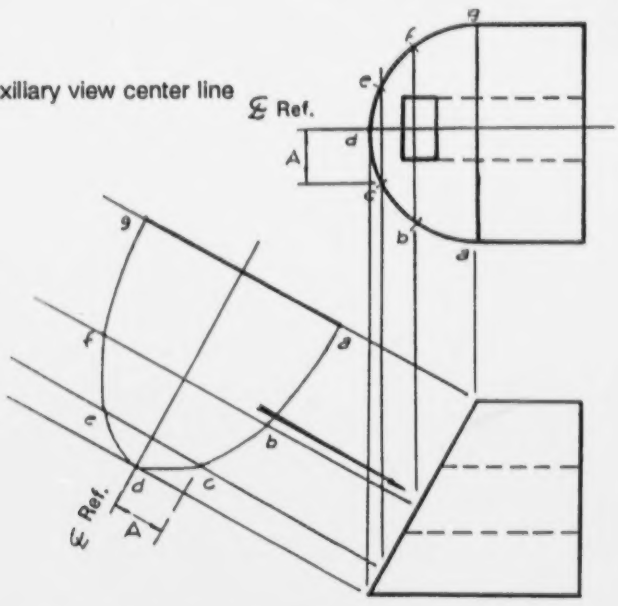


2. Assume a line of sight perpendicular to the edge of the sloped surface

3. Project points of circle in top view to edge of surface in front view

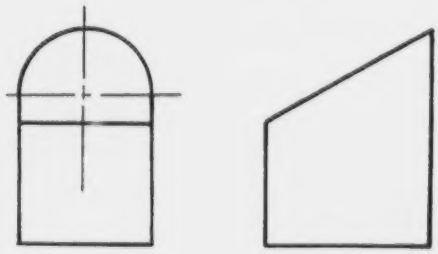
4. Project these points of intersection perpendicular to the surface edge and introduce reference plane center line

5. Transfer points from top view center line to auxiliary view center line

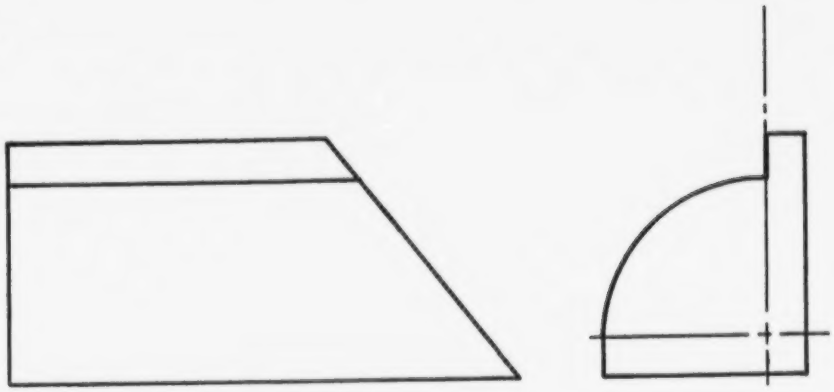


Directions: Construct a true size auxiliary view of the following inclined surfaces.

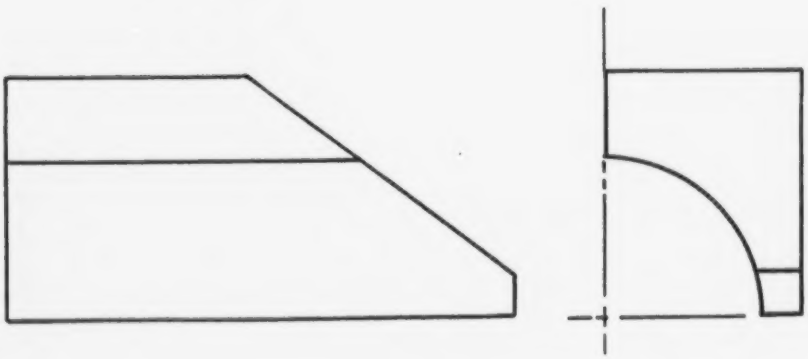
Problem A:



Problem B:



Problem C:



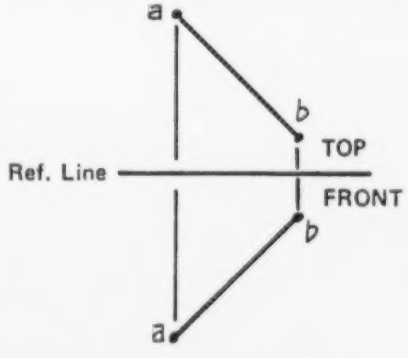
CONSTRUCT TRUE LENGTH

OF AN OBLIQUE LINE

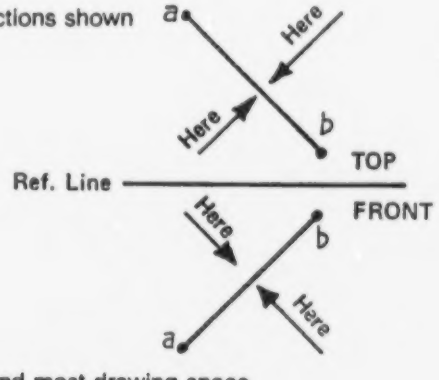
Premise: When a line is oblique to any principal views, an auxiliary view is required to find the true length. True length of an oblique line can be constructed by using the procedure in the following example.

Example:

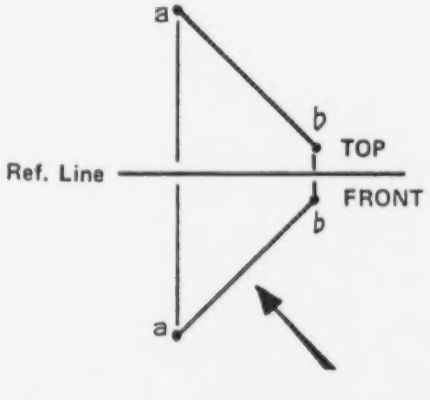
1. Use given two views of a skewed line a-b



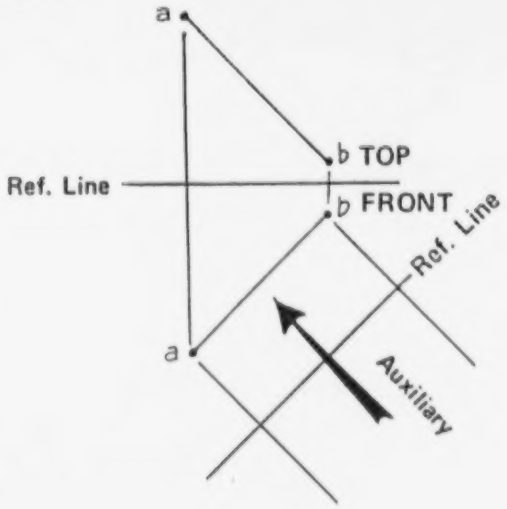
2. Assume 90° line of sight from any one of the four directions shown



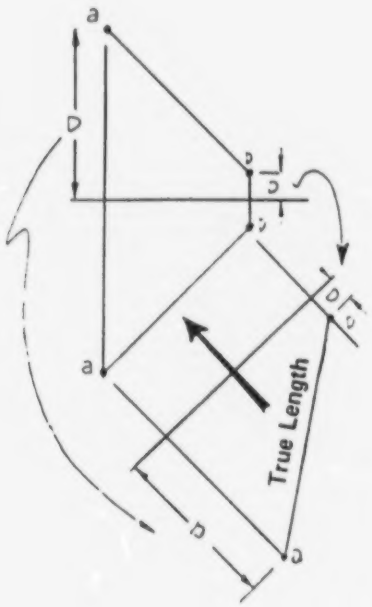
3. Select a line of sight with least amount of congestion and most drawing space



4. Assume reference line at a convenient distance perpendicular to line of sight; project points a-b through reference plane

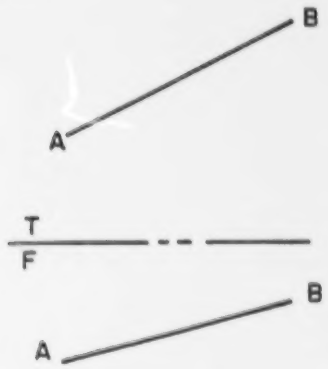


5. Transfer points a and be from top view and connect points to form true length line

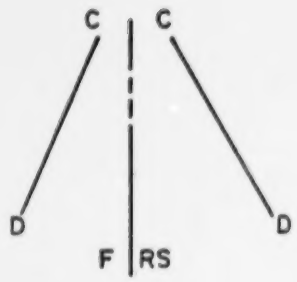


Directions: Construct true length of the lines given below. Label line TL.

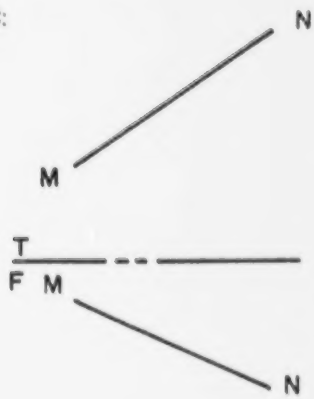
Problem A:



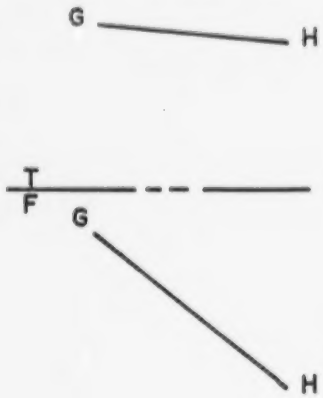
Problem B:



Problem C:



Problem D:



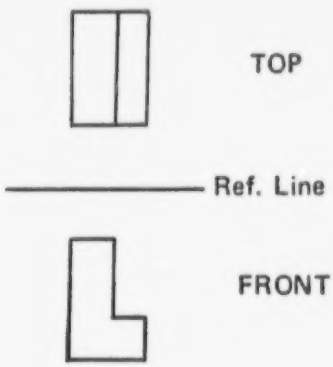
CONSTRUCT A SECONDARY

AUXILIARY VIEW OF AN OBJECT

Premise: An infinite number of views can be taken from any view of an object. The first auxiliary off the orthographic view is called a primary auxiliary view. An auxiliary off a primary auxiliary view is called a secondary auxiliary. A secondary auxiliary view can be constructed by using the procedure in the following example. An auxiliary can be drawn of any angle desired or needed for this procedure.

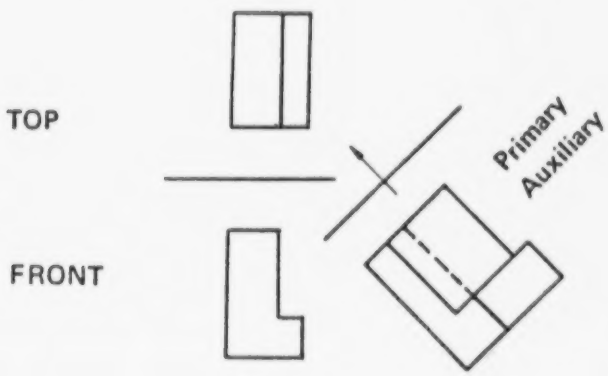
Example:

1. Use given top and front view of a simple object; assume a line of sight at angle indicated

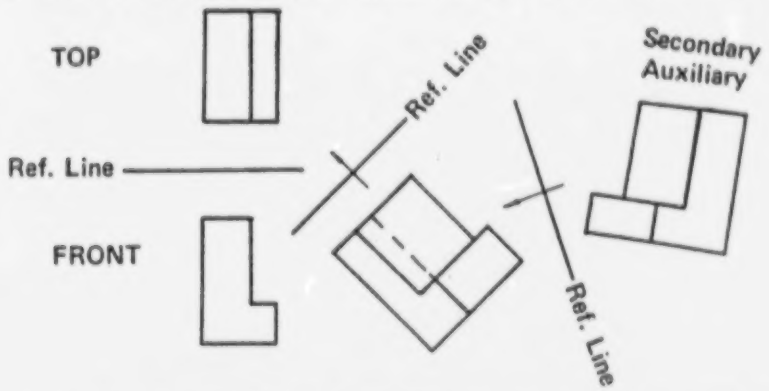


2. Project each point to auxiliary view and transfer point distances from front view

   NOTE: Always skip a view for transfer of measurements.



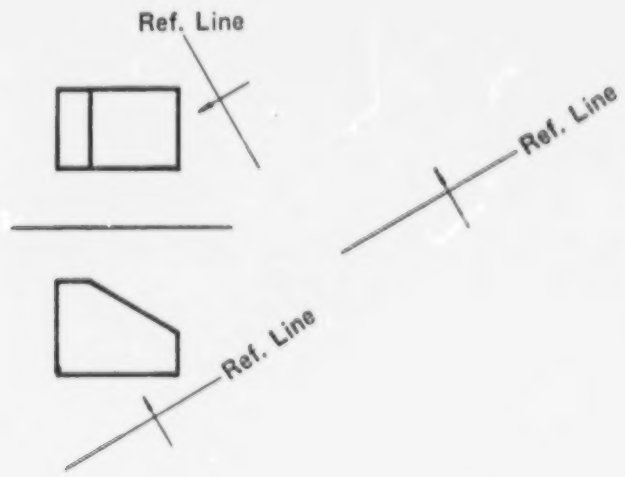
3. Assume another line of sight for view number two; transfer dimensions from top view



NOTE: This process can go on indefinitely from any view in any direction. The principle is the same and the basic steps are the same.

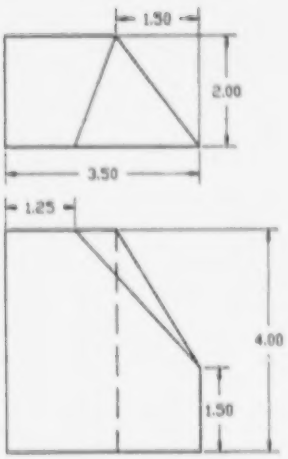
Directions: Construct auxiliary views at lines of sight indicated.

Problem A:

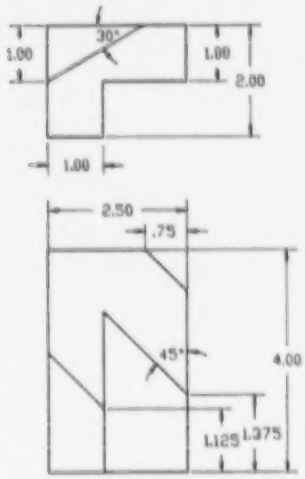


Directions: Draw secondary auxiliary views, complete, which will show the true sizes of the inclined surfaces. Use metric or decimal-inch dimensions as assigned by the instructor.

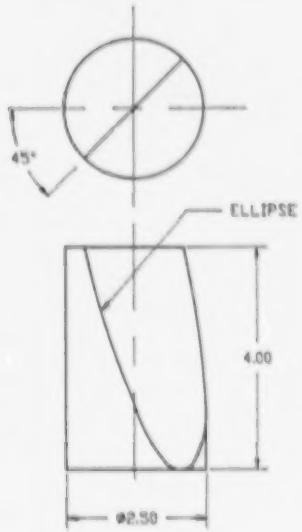
Problem B:



Problem C:



Problem D:

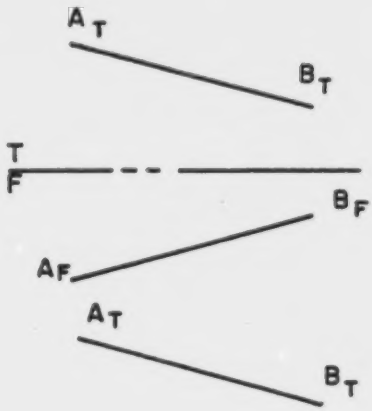


CONSTRUCT POINT VIEW OF A LINE

Premise: Determining the point view of a line is basic for projection of a secondary auxiliary view. The procedure given in the example is for determining point view of only one line. The procedure for finding point view of oblique lines is the same. Point view of a line can be constructed by using the procedure in the following example.

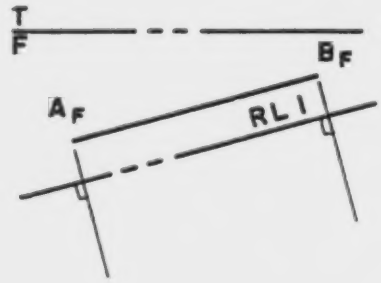
Example:

1. Use given top and front view of line AB

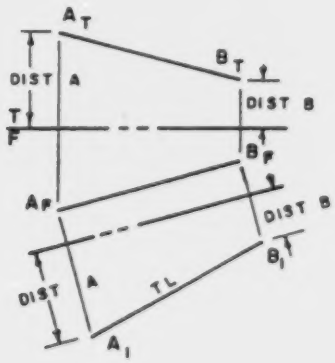


2. Construct reference line RL1 parallel to line A_F B_F

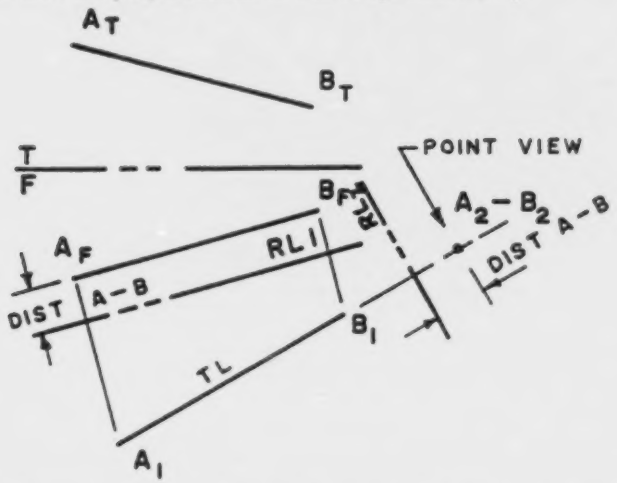
   NOTE: Top view could have been used.



3. Find true length of line A_F T_F by projecting end points from front view, then transfer from top view

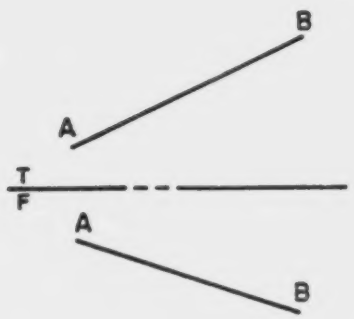


4. Construct reference line RL2 perpendicular to true length line A_1 B_1



5. To find point view of line, transfer distance from front view and project line A_1 B_1 to secondary auxiliary view

Directions: Construct a point view of a line in the following problem. Label end points of lines in construction. Leave construction lines.



CONSTRUCT TRUE LENGTHS OF LINES BY ROTATION

Directions: Construct true lengths of lines by rotation as outlined in the procedure of the following example.

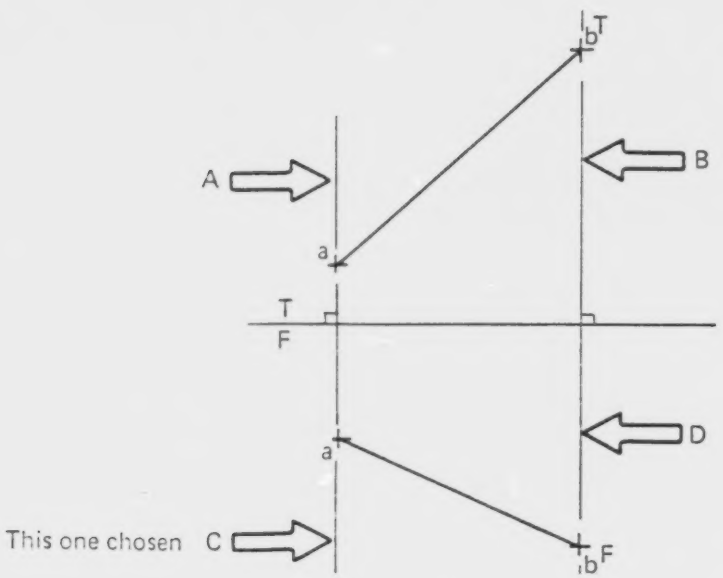
Example:

1. Select axis of rotation

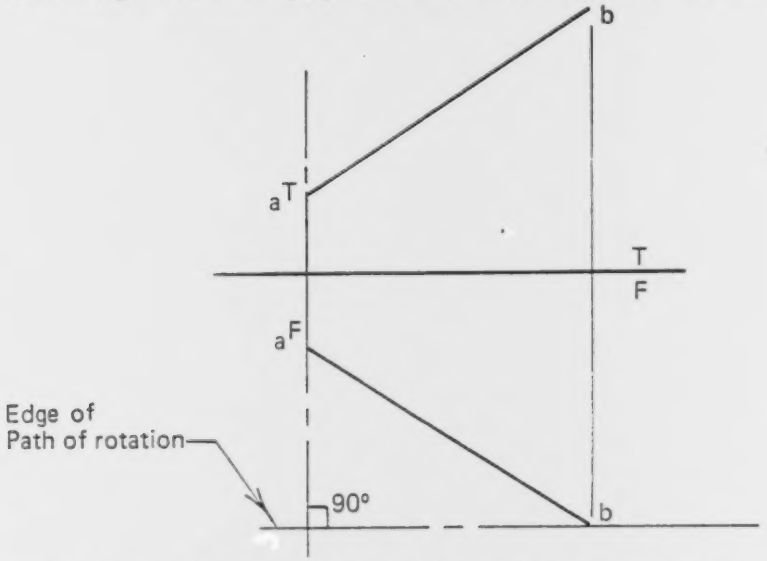
   a. Any one of the following could be chosen: A, B, C, or D; it must be perpendicular to the folding line

   b. Your choice depends on what view you want TL in and what point you want rotated

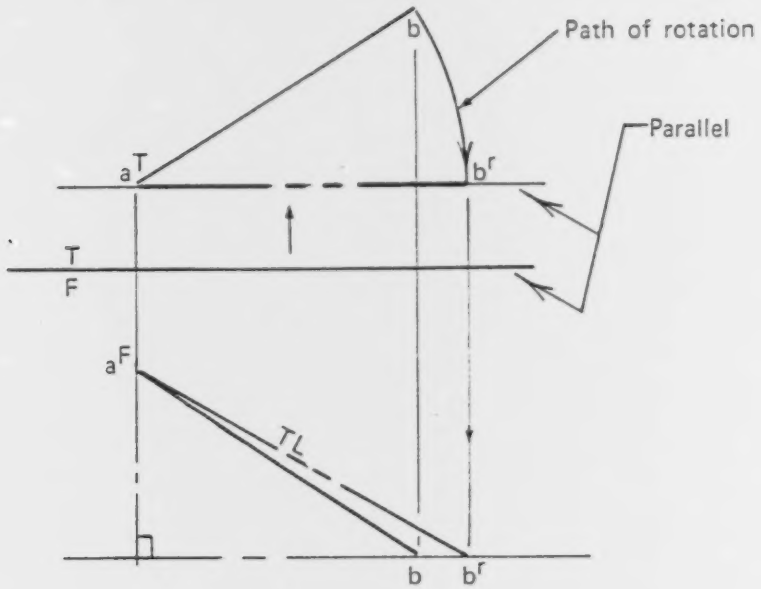
   c. In this example, axis "C" was chosen so TL will be in front view



2. Construct path of rotation perpendicular to axis through the point to be rotated



3. In the adjacent view, construct a path of rotation from "b" to a position where "ab" will be parallel to the folding line; mark new point b^r and project to adjacent view

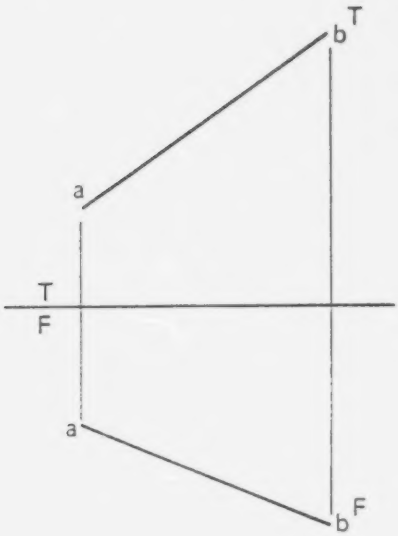


4. Connect "a" to the new b^r in the front view; mark it TL

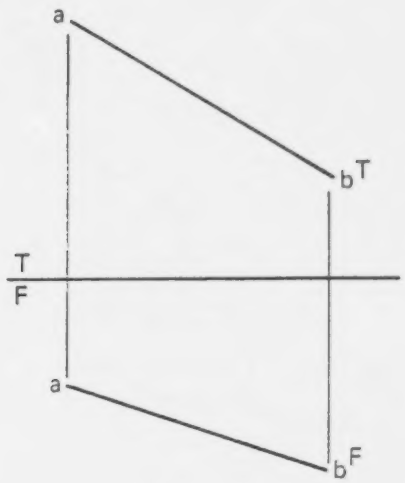
(NOTE: Line ab^r is in TL because it has been rotated parallel to the front plan or perpendicular to the LOS.)

Problems:

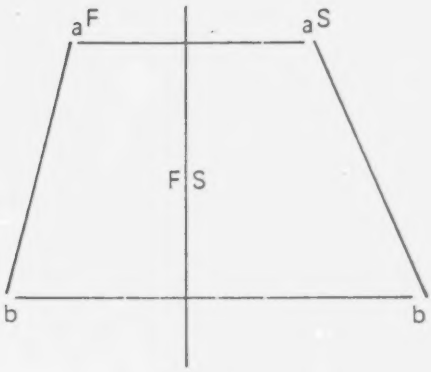
A. Find TL in front view



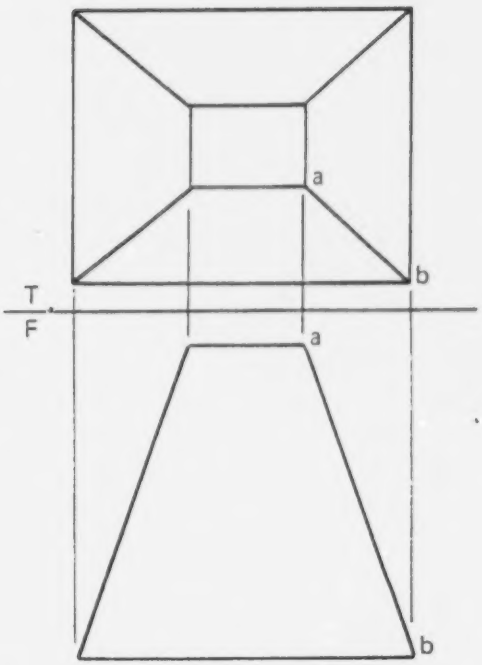
B. Find TL in top view



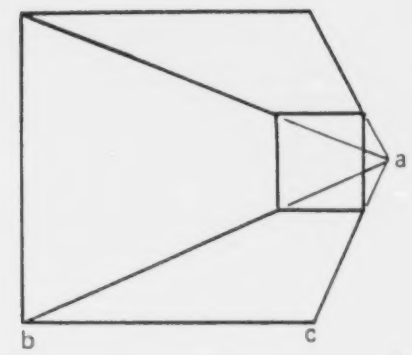
C. Find TL in side view



D. Find TL in front view

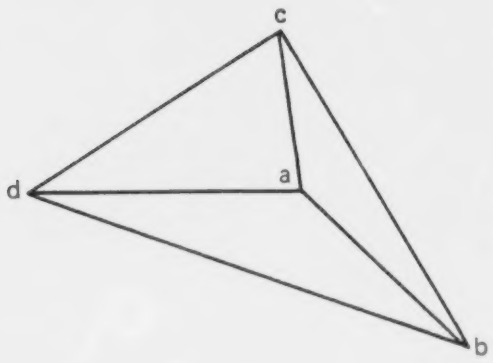


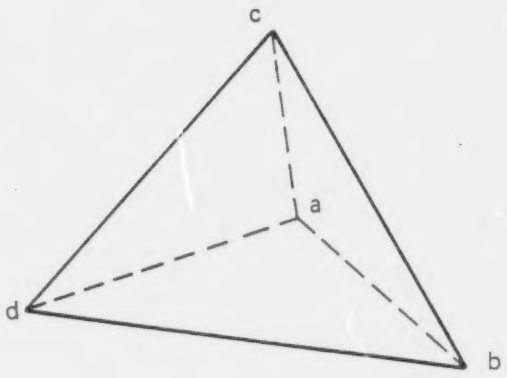
E. Find TL of ab and ac



TL of ab = _____
TL of ac = _____

F. Find TL of ab, ac, and ad





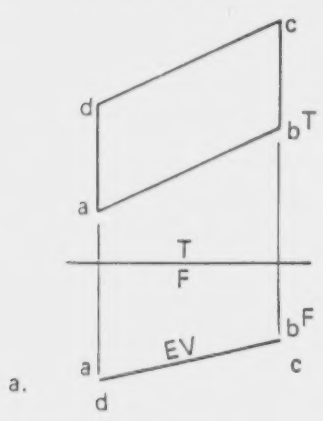
TL of ab = _____
TL of ac = _____
TL of ad = _____

CONSTRUCT TRUE SIZES OF PLANES BY ROTATION

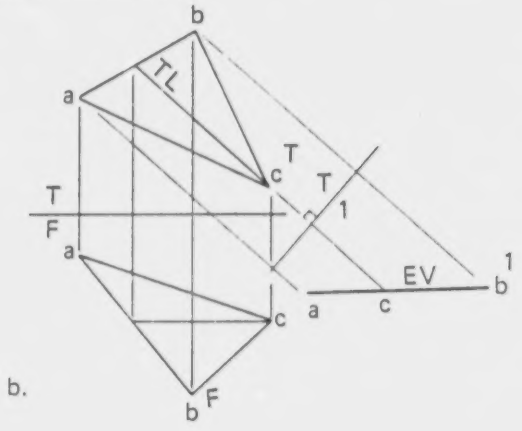
Directions: Construct true sizes of planes by rotation using the procedure in the following examples as a guideline.

Example:

1. Construct or identify edge view of plane as shown in a and b



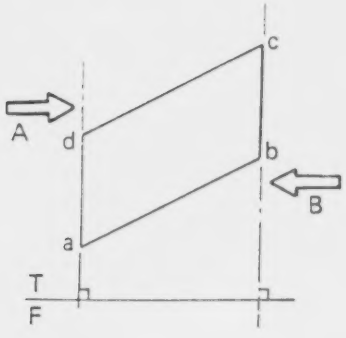
a.

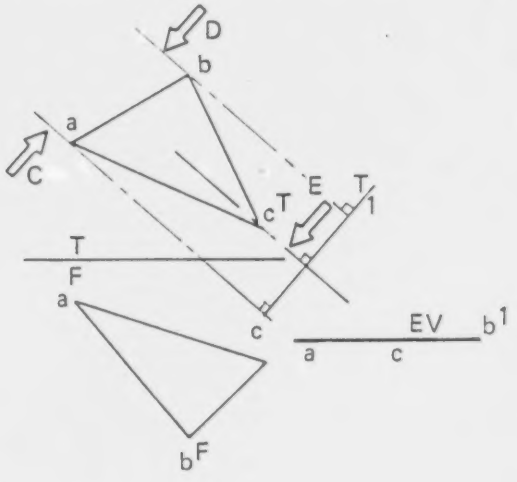


b.

2. Select axis of rotation

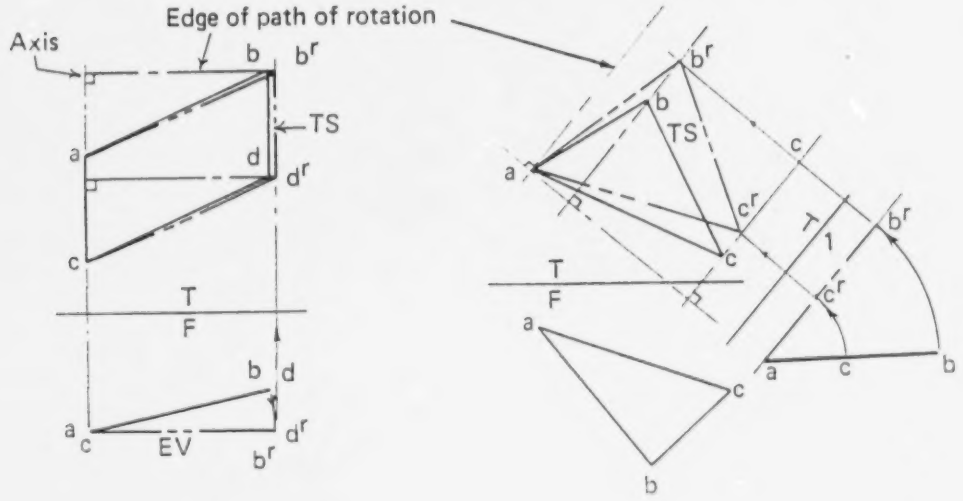
   a. Any axis could be chosen, but it must be perpendicular to the folding line next to the edge view





   b. Your choice depends on what points you want to rotate

3. Construct the edge of the path of rotation perpendicular to axis through the points to be rotated

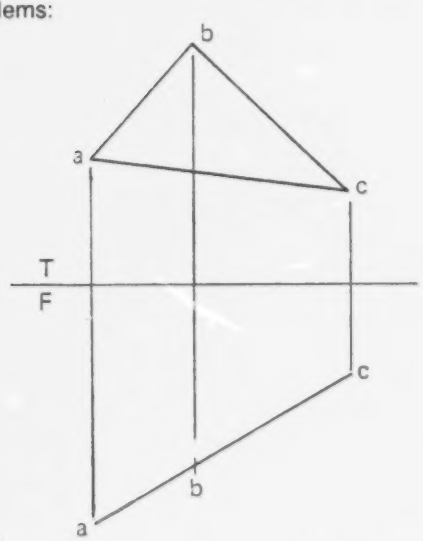


4. In the edge view, construct a path of rotation from center point to a position parallel to the folding line, and mark new point

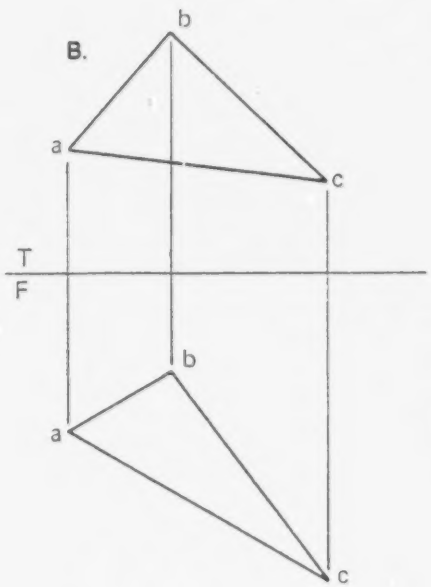
5. Construct all points forming true size of plane

Problems:

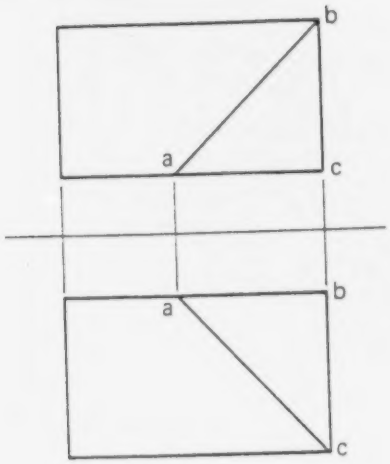
A.



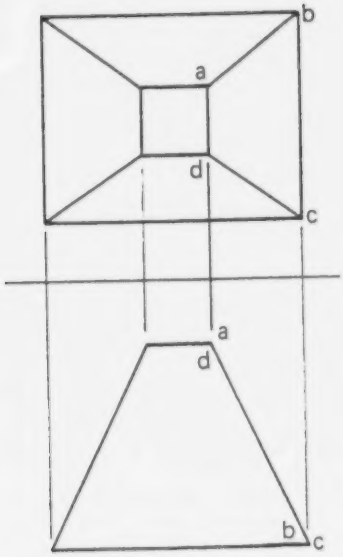
B.



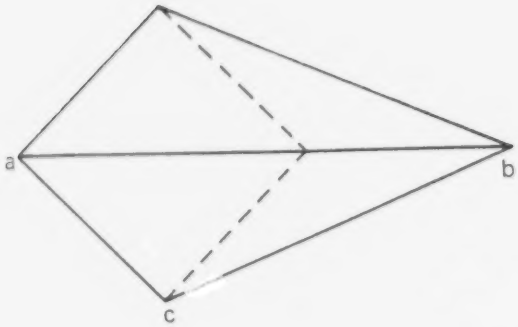
C.



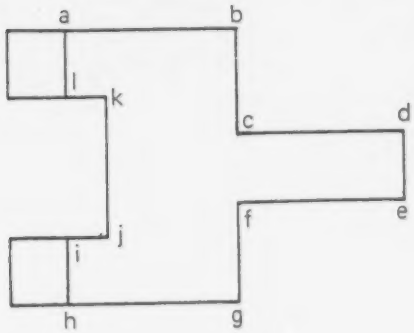
D.

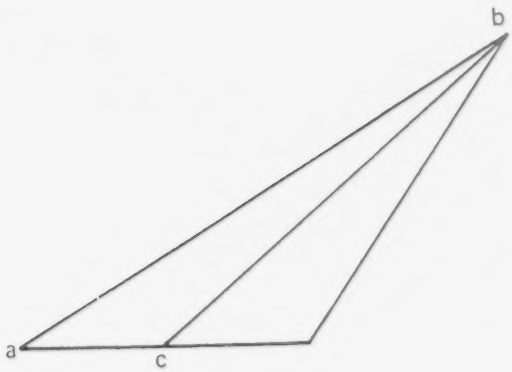


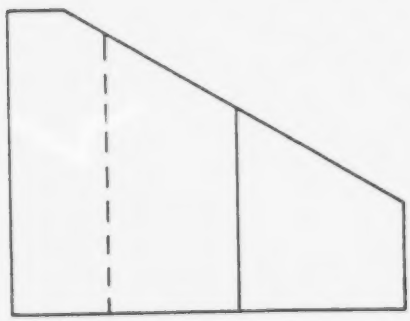
E.



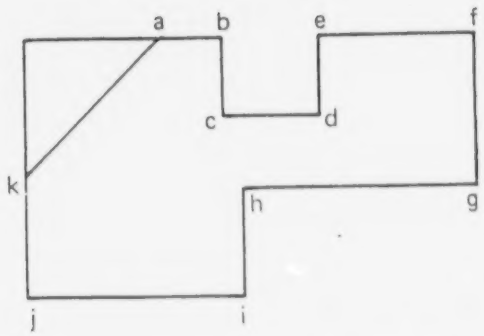
F.



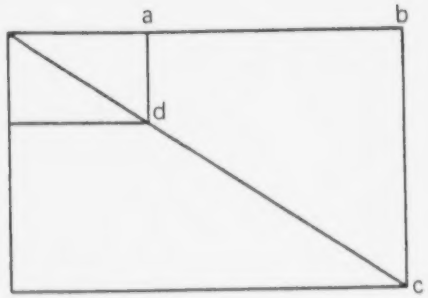


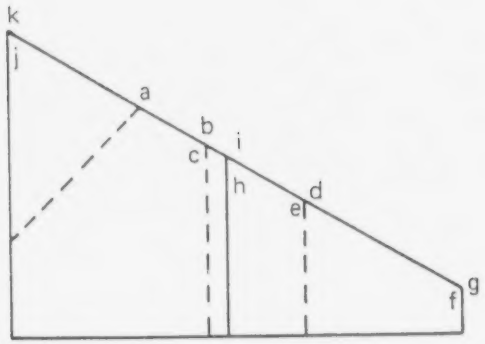


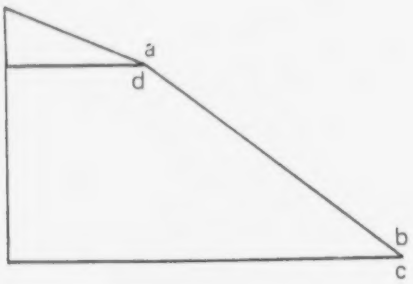
G.



H.

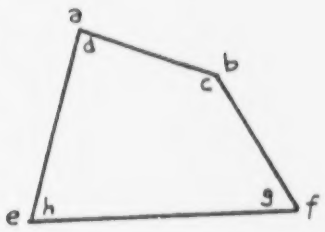






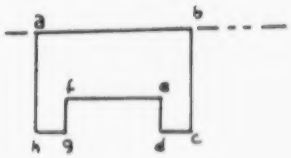
ANSWERS TO ASSIGNMENTS SHEETS

AS 1.1

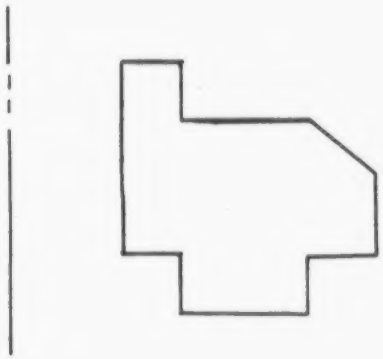


AS 1.2

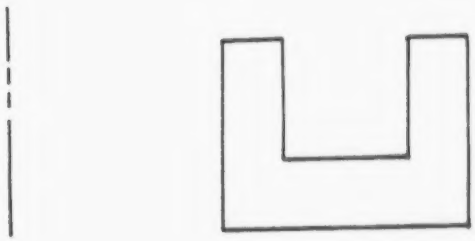
A.



B.

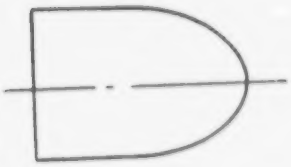


C.

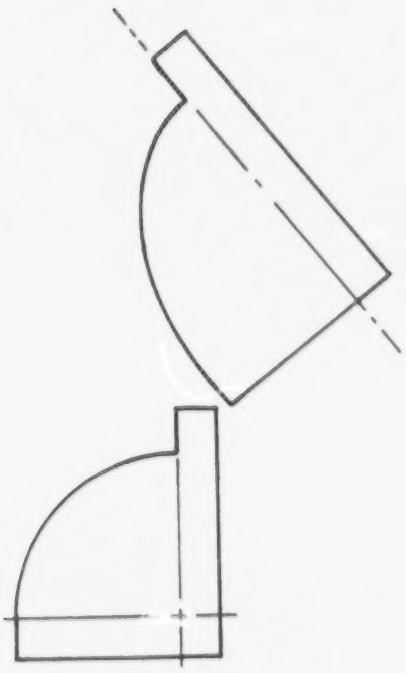


AS 1.3

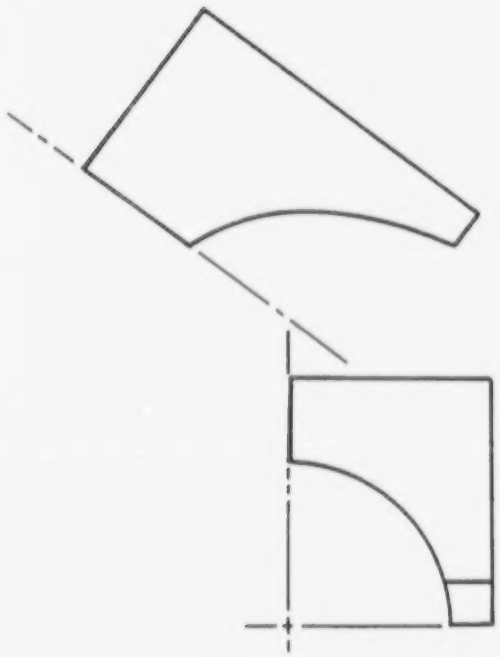
A.



B.

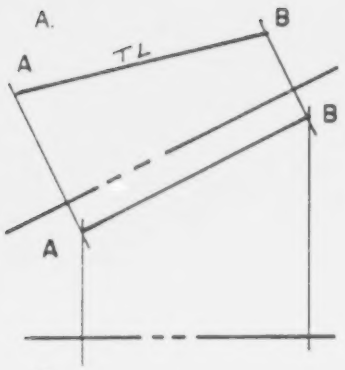


c.



AS 1.4

A.



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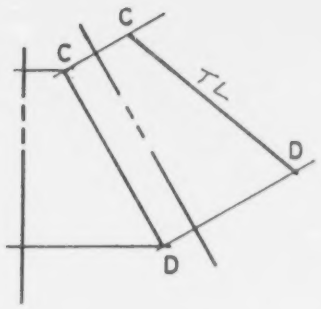

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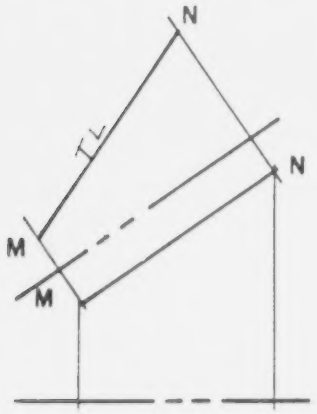

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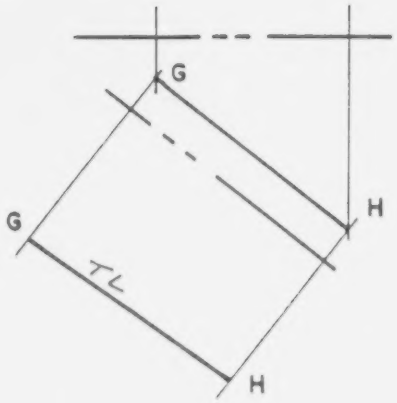
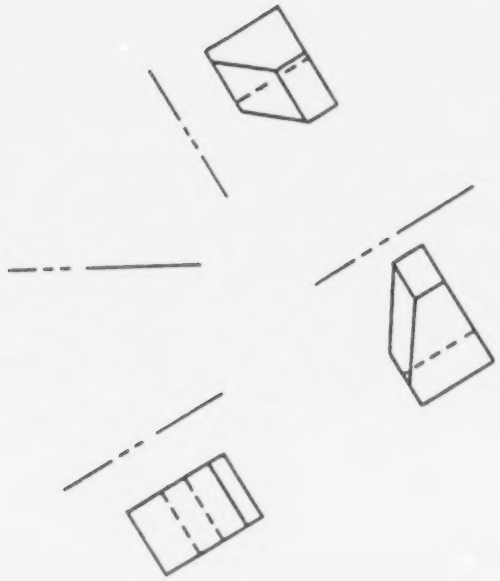


AS 1.5

A:



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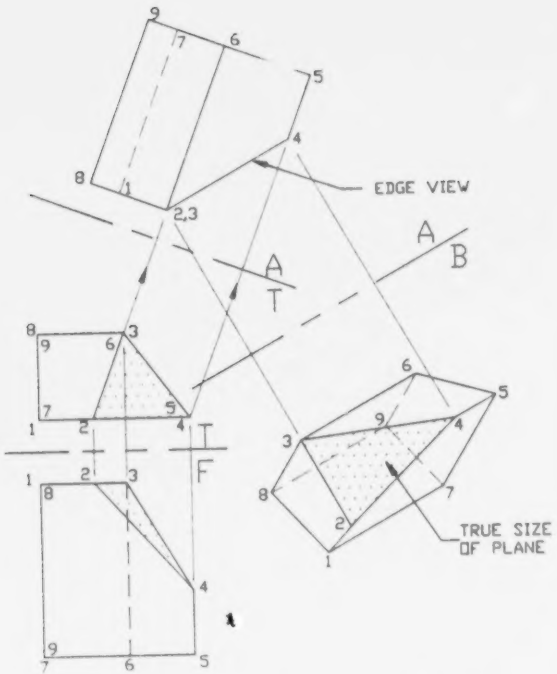

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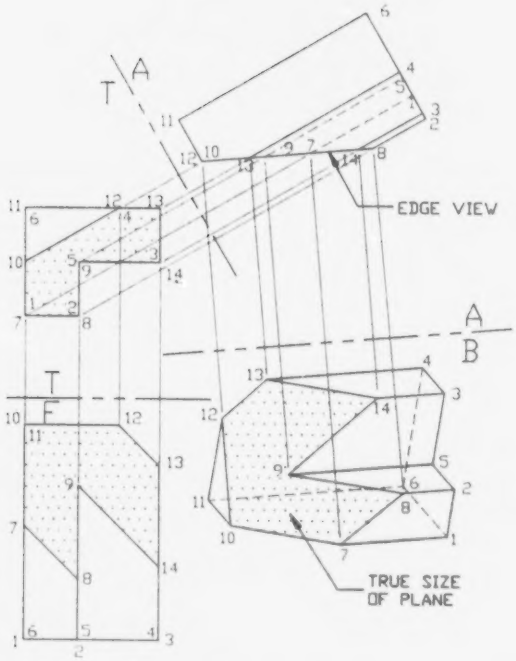

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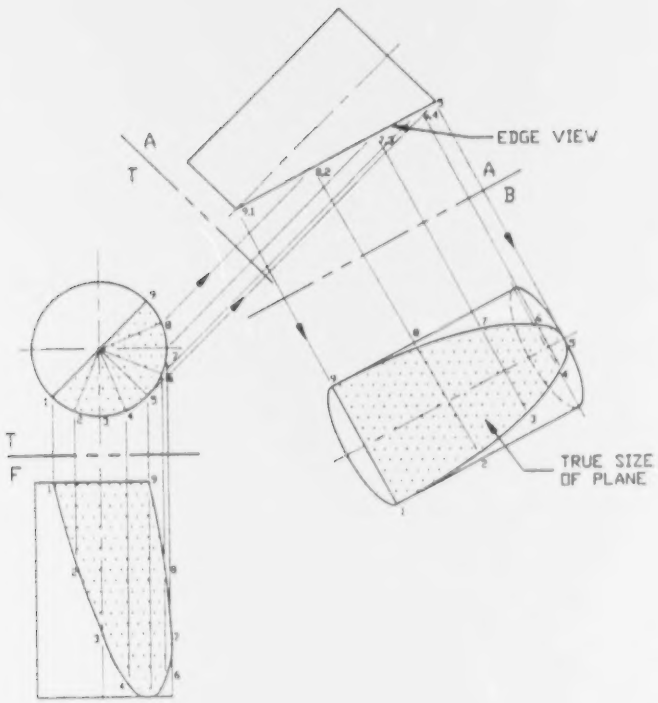

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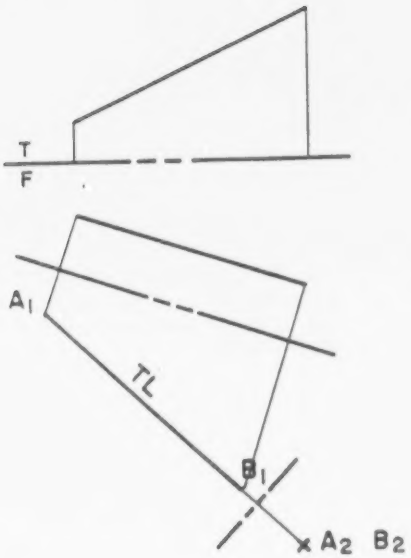

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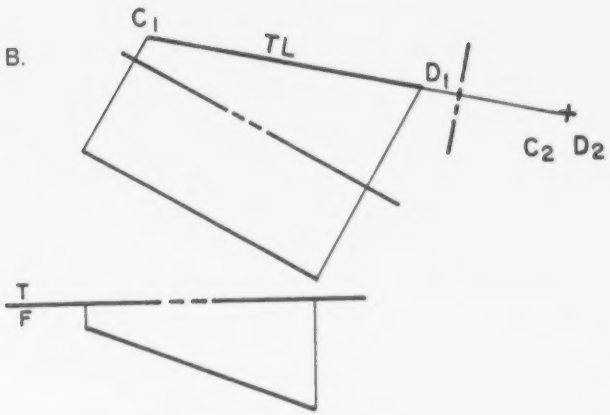

AS 1.7 Done to instructor's satisfaction

AS 1.8 Done to instructor's satisfaction

MODULE: RELATED VIEWS AND DESCRIPTIVE GEOMETRY

UNIT I: AUXILIARY VIEWS AND REVOLUTIONS

UNIT TEST

Match the terms on the right with their correct definitions on the left.

____	1.	A line representing the inclined plane	a. Partial auxiliary
____	2.	A view or surface that is not perpendicular or right angle to the plane of projection	b. Inclined plane
____	3.	Direction from which an object is being viewed	c. True size
____	4.	Shows only the true size and detail of the inclined plane	d. Auxiliary view
____	5.	A plane that is foreshortened in two principal viewing planes and edge view in one other principal viewing plane	e. Oblique plane
____	6.	To appear shorter to the eye than it actually is	ab. Edge view
____	7.	A first projection of an inclined plane from one of the principal views	ac. Line of sight
____	8.	Oblique plane or line projected from a primary auxiliary view and one of the principal views	ad. Foreshortened
____	9.	A surface that is shown in its actual size	ae. Primary auxiliary view
____	10.	A plane that is foreshortened in all three principal viewing planes	bc. Secondary auxiliary view

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Match the terms on the right with their correct definitions on the left.

____	11.	Take from one point or view and put in another view	a.	Symmetrical
____	12.	A line that appears in its actual length	b.	Perpendicular line
____	13.	A line at 90° to a given plane of projection	c.	Fold line
____	14.	A common line on back side, center, front side, or between views from which depth measurements are taken	d.	Slope
____	15.	A theoretical line between two views where viewing planes fold	e.	True length line
____	16.	Has same shape and size on opposite sides of a center line	ab.	True angle
____	17.	Nonintersecting lines, not parallel to each other or to the principal views	ac.	Grade
____	18.	The degree of inclination of a slope	ad.	Skew lines
____	19.	The angle a line makes with the horizontal plane	ae.	Transfer
____	20.	An angle formed by two intersecting planes	bc.	Reference line

Select true statements concerning uses of auxiliary views by placing an "a" in the appropriate blanks. Mark a "b" for false statements.

____ 21. Determine clearance distances and angles between manufactured parts

____ 22. Describe inclined surfaces of manufactured parts

____ 23. Project any length of structural members

Select true statements concerning projection of measurements in a primary auxiliary view by placing an "a" in the appropriate blanks. Mark a "b" for false statements.

____ 24. Depth and height measurements are transferred with a scale or dividers in their true length form one of five views

____ 25. Make all measurement views from the edge view

____ 26. Length measurements are projected in their true length perpendicular from edge view to primary auxiliary

Select true statements concerning projection of measurements in a secondary auxiliary view by placing an "a" in the appropriate blanks. Mark a "b" for false statements.

____ 27. Depth measurements are transferred from the edge view of one of the principal views

____ 28. Length measurements are projected from edge view

29. **Name the views from which a primary auxiliary can be projected.**

_____

30. **List the different locations of a reference line.**

a. _____

b. _____

c. _____

Select true statements concerning characteristics of rotation by placing an "a" in the appropriate blanks. Mark a "b" for false statements. (All parts of a statement must be true before you place an "a" by that statement. If one part is false, the whole statement is considered false.)

___ 31. The path of rotation of any point not on the axis appears as a rectangle in a view showing the axis of rotation as a point.

___ 32. The plane of the path of rotation of any point appears in edge view (EV) and perpendicular to the axis in a view showing the axis of rotation in true length.

___ 33. In true lengths by rotation,
- a. A line may be rotated until it is parallel to a principal plane
- b. The line is projected onto the adjacent plane
- c. Since it is parallel to the folding line, it is in true length in the adjacent plane

___ 34. In true sizes of rotation,
- a. An edge view may be rotated until it is parallel to an orthographic plane
- b. The edge view is then projected onto the plane and is foreshortened in size

35. Name a method of projection in which the observer stays stationary and the object is rotated for different views of the object.

_____

ANSWERS TO UNIT I TEST

1. ab
2. d
3. ac
4. a
5. b
6. ad
7. ae
8. bc
9. c
10. e
11. ae
12. e
13. b
14. bc
15. c
16. a
17. ad
18. ac
19. d
20. ab
21. a
22. a
23. b
24. a
25. b
26. a
27. a
28. b
29. All six views
30. The following in any order:
    a. Back edge of view
    b. Center line
    c. Front edge of view
    d. Between views
31. b
32. a
33. a
34. b
35. Rotational

MODULE: RELATED VIEWS AND DESCRIPTIVE GEOMETRY

UNIT II: SECTIONAL VIEWS/CONVENTIONS

UNIT OBJECTIVES

After completion of this unit, the student should be able to construct material symbols and full, half, offset, broken-out, removed, revolved, rib, aligned, and assembly sections. The student should also be able to construct conventional breaks. This knowledge will be evidenced by correctly performing the procedures outlined in the assignment sheets and by scoring ___ percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1.1 Match terms related to sectional views with their correct definitions.

1.2 Identify types of sectional views.

1.3 Identify material symbols in section.

1.4 Match types of sections with their correct uses.

1.5 Identify line type and thickness used in sectional drawings.

1.6 Select the most commonly used form of cutting plane lines.

1.7 Select true statements concerning general rules in sectioning.

1.8 Identify types of conventional breaks.

1.9 Select true statements concerning use of unlined sections.

1.10 Select true statements concerning labeling sectional views.

1.11 Demonstrate the ability to:

a. Construct a full section of an object.

b. Construct a half section of an object.

c. Construct an offset section of an object.

d. Construct a broken-out section of an object.

e. Construct a removed section of an object.

f. Construct a revolved section of an object.

g. Construct a rib section of an object.

h. Construct an aligned section of an object with holes, ribs, or spokes.

i. Construct adjacent parts in assembly section.

j. Construct conventional breaks.

MODULE: RELATED VIEWS AND DESCRIPTIVE GEOMETRY

UNIT II: SECTIONAL VIEWS/CONVENTIONS

CONTENTS OF THIS UNIT

A. Objective sheets

B. Notes to the instructor

C. References

D. Lesson 1: SECTIONAL VIEWS AND CONVENTIONS

a. Information outline

b. Transparency masters

TM 1.1: Full Section
TM 1.2: Half Section
TM 1.3: Offset Section
TM 1.4: Broken-Out Section
TM 1.5: Removed Section
TM 1.6: Revolved Section
TM 1.7: Aligned Section
TM 1.8: Aligned Section (Continued)
TM 1.9: Rib Section
TM 1.10: Assembly Section
TM 1.11: Material Symbols in Section
TM 1.12: Direction of Section Lines
TM 1.13: Materials in Assembly Section
TM 1.14: Visible Lines
TM 1.15: Hidden Lines
TM 1.16: Hidden and Symmetry Line Application
TM 1.17: Thin Sections
TM 1.18: Outline Sections
TM 1.19: Errors in Making Section Lines

c. Handouts

HO 1.1: Full and Half Section
HO 1.2: Offset and Broken-Out Section
HO 1.3: Removed and Revolved Section
HO 1.4: Aligned Section
HO 1.5: Rib Section
HO 1.6: Direction of Section Lines
HO 1.7: Material Symbols in Section

d. Assignment sheets

AS 1.1: Construct a Full Section of an Object
AS 1.2: Construct a Half Section of an Object
AS 1.3: Construct an Offset Section of an Object
AS 1.4: Construct a Broken-Out Section of an Object
AS 1.5: Construct a Removed Section of an Object
AS 1.6: Construct a Revolved Section of an Object

AS 1.7: Construct a Rib Section of an Object
AS 1.8: Construct an Aligned Section of an Object with Holes, Ribs, or Spokes
AS 1.9: Construct Adjacent Parts in Assembly Section
AS 1.10: Construct Conventional Breaks

E. Answers to assignment sheets

F. Unit test

G. Answers to unit test

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1. Brown, Walter C. Drafting for Industry. Revised ed. South Holland, Ill. 60473: Goodheart-Willcox Co., Inc., 1990.

2. Davis, Ronald, Bill Hill and Bruce Yancey. Basic Drafting: Book Two. Stillwater, Okla. 74074: Mid-America Vocational Curriculum Consortium, Inc., 1981.

3. Dygdon, John Thomas, Frederick E. Giesecke, Ivan Leroy Hill, Alva Mitchell, and Henry Cecil Spencer. Technical Drawing, 8th edition. New York: MacMillan Publishing Company, 1986.

4. Jensen, Cecil and Jay Helsel. Engineering Drawing and Design. New York: Gregg Division/McGraw-Hill Book Co., 1979.

5. Spence, William P. Drafting Technology and Practice. Revised ed. Pittsburgh, Kan. 66762: Bennett & McKnight Publishing Company, 1980.

6. Wallach, Paul Ross and Dean Chawenhill. Drafting in a Computer Age. Albany, N.Y. Delmar Publishers, Inc., 1989.

NOTES TO THE INSTRUCTOR

A. Suggested approaches to teaching this unit

1. Construct "cutaway models" of various object to illustrate sectional views.

2. Display cutaway parts of sectional views in classroom for students to inspect.

3. Discuss the use of sectional views.

MODULE: RELATED VIEWS AND DESCRIPTIVE GEOMETRY

UNIT II: SECTIONAL VIEWS/CONVENTIONS

LESSON 1: SECTIONAL VIEWS AND CONVENTIONS

I. Terms and definitions

A. **Aligned section**--used to align features such as spokes, holes, and ribs along a common plane so that they can be detailed more easily

B. **Assembly section**--shows all parts of an object as one unit and drawn using section lining to make the individual parts stand out

C. **Broken-out section**--an area broken out of a view that shows only a portion of that view in section

D. **Conventional break**--used in making a shortened view of a long, simple object

NOTE: Do not remove holes from object in shortened view.

E. **Cutting plane**--an imaginary plane used to cut through an object.

F. **Full section**--the cutting plane passes completely through an object and the cross section behind the cutting plane line is exposed to view

G. **Half section**--the cutting planes are passed at right angles to each other along the center lines, and one-fourth of object is removed

H. **Offset section**--has a cutting plane line to pick up features that are not along the center lines, and one-fourth of object is removed

I. **Outline sectioning**--section lines are shown along the borders of a large part for clarity and to save time

J. **Removed section**--a revolved section drawn off the principal view and placed in another convenient location

K. **Revolved section**--a cutting plane line is passed through an area and then the image is revolved 90° in position

L. **Rib section**--method of not showing the ribs section lined eliminates the impression of solidity

M. **Section lining**--a line symbol that is drawn on exposed cut surface; sometimes called cross hatching

N. **Section symbols**--symbolic section lining used for indication of various materials

NOTE: Do not use on microfilm drawings; use standard cast iron symbol.

O. **Sectional view**--the imaginary cutting away from front viewing portion of the object to show the interior detail

P. **Subtitles**--labeling with capital letters the sectional view which has a removed section

Q. **Symmetry**--having the same shape and size on opposite sides of a center line

R. **Thin section**--used for clarity in sections of assembly drawings of standard parts where the axis of the part lies in the cutting plane

S. **Unlined section**--used for clarity in sections of assembly drawings of standard parts where the axis of the part lies in the cutting plane

NOTE: When the axis lies at right angle to cutting plane, the part is sectioned.

II. Types of sectional views

A. Full section (TM 1.1) (HO 1.1)

B. Half section (TM 1.2) (HO 1.1)

C. Offset section (TM 1.3) (HO 1.2)

D. Broken-out section (TM 1.4) (HO 1.2)

E. Removed section (TM 1.5) (HO 1.3)

F. Revolved section (TM 1.6) (HO 1.3)

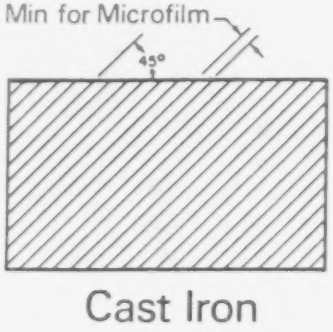
G. Aligned section (TM 1.7 and 1.8) (HO 1.4)

H. Rib section (TM 1.9) (HO 1.5)

I. Assembly section (TM 1.10)

III. Material symbols in section (TM 1.11)

A. General (cast iron)



NOTE: Current ANSI standards say use the cast iron symbol and identify the material. Other symbols are included on HO 1.7 to identify previously used standards.

IV. Types of sections and their uses

A. Half section--to show both interior and exterior features of a symmetrical object

B. Revolved section--to show the true shape of the cross section of a long object such as a bar, spoke, rib, or arm

C. Offset section--to show features that are not in a straight line

D. Broken-out section--to show interior detail of objects where less than half section is required

E. Removed section--used for clearness and for easier dimensioning

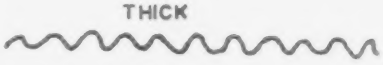
F. Full section--used for clearness and for easier dimensioning

G. Aligned section--used when true projection would be confusing for spokes, ribs, and holes

V. Line type and thickness used in sectional drawings

A. Section line, thin--

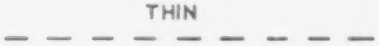
B. Short break line, thick--



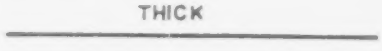
C. Long break line, thin--

D. Cutting plane line, thick--

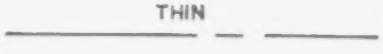
E. Visible line, thick--



F. Hidden line, thin--



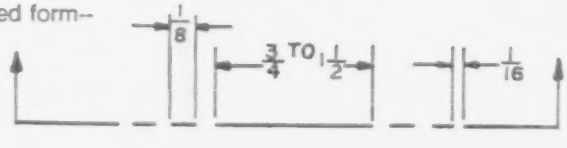
G. Center line, thin--



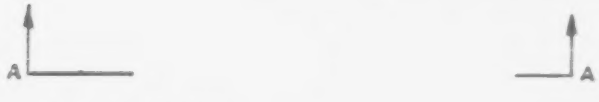
VI. Forms of cutting plane lines

A.

B. Most commonly used form--



C.



VII. General rules in sectioning

A. Hidden lines behind the cutting plane should be omitted unless needed (TM 1.2 and 1.14)

B. Sections which are too thin for effective section lining are shown solid (TM 1.7)

C. Large surfaces are often sectioned only along the edge of the part (TM 1.18)

D. If two or more sections appear on the same drawing, the cutting plane lines are labeled and the view is subtitled (TM 1.5)

E. Section lines are thin parallel lines drawn at 45° to main outline of the view (TM 1.11 and 1.12)

F. In assembly sectional view, the adjacent parts section lines should be drawn at a 30°, 45°, or 60° angle to the edge of object (TM 1.10)

G. Section lines are uniformly spaced from approximate .06 to .125 (TM 1.11 and 1.12)

NOTE: Minimum space of .18 is used for microfilm.

H. Arrowheads at the ends of the cutting plane line indicate the direction in which the section is viewed (TM 1.1)

I. Where two or more thin sections are shown, a space should be left between them

NOTE: For microfilm process see TM 1.17.

J. When the cutting plane offsets, a line is not shown in the sectioned view to present the offset (TM 1.3)

K. When objects have one major center line, the cutting plane line may be omitted (TM 1.14)

L. Except for revolved sections, section views should be projected in the normal orthographic view (TM 1.1, 1.2, 1.3, 1.4, 1.5, 1.9 and 1.10)

M. When dimensions on sectioned areas are unavoidable, the section lining should be omitted for the numerals or lettering (TM 1.12)

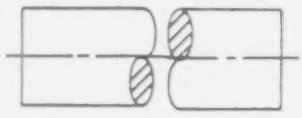
N. A center line or a visible line may be used to divide the sectioned half from the unsectioned half (TM 1.2)

O. Hidden lines may be added to unsectioned half for dimensioning (TM 1.2)

P. Visible lines behind cutting plane line should not be omitted (TM 1.13)

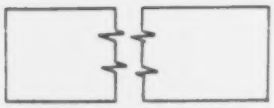
VIII. Types of conventional breaks

A. Round bar

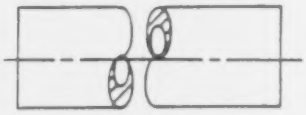


B. Rectangular solid

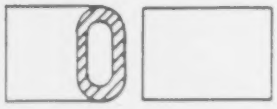
C. Long break



D. Round tubular



E. Rectangular tubular



IX. Common errors in making section lines (TM 1.19)

A. Irregular spacing

B. Varying line weight

C. Lines too thick

D. Lines short or over run visible lines

X. Use of unlined sections (TM 1.10, 1.13, 1.17)

A. Thin parts are made solid

B. Shafts, bolts, nuts, pins, keys, rivets, gear teeth, and similar parts should not be sectioned if axis lies in cutting plane

C. Broken-out section of shaft may be made to indicate clearness of key, key seat, and pin

XI. Methods used to aid equal spacing of section lining

A. Visual spacing

B. Line guide

NOTE: Scribed line on triangle may be used.

C. Trace lines from a grid sheet

D. Measure with scale

XII. Labeling sectional views (TM 1.5)

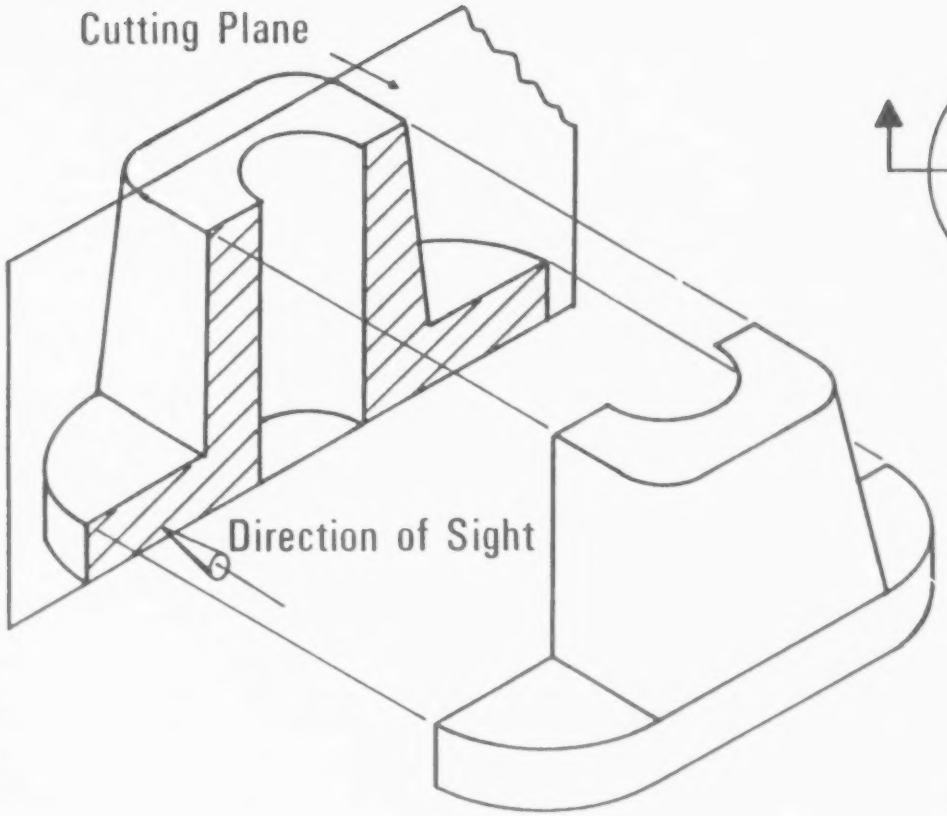
A. More than one removed section view should be labeled with letters corresponding to the ends of the cutting plane line

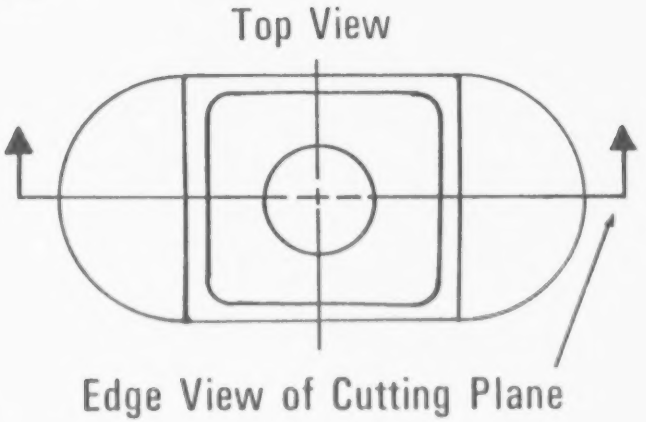
B. Sectional views should be arranged in alphabetical order from left to right on the drawing

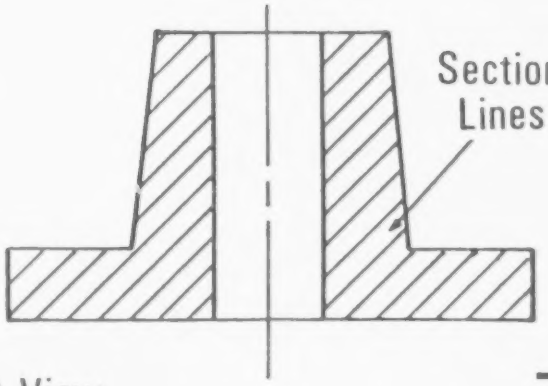
C. Section letters should be used in alphabetical order

D. Letters "I", "O", and "Q" should not be used

Full Section



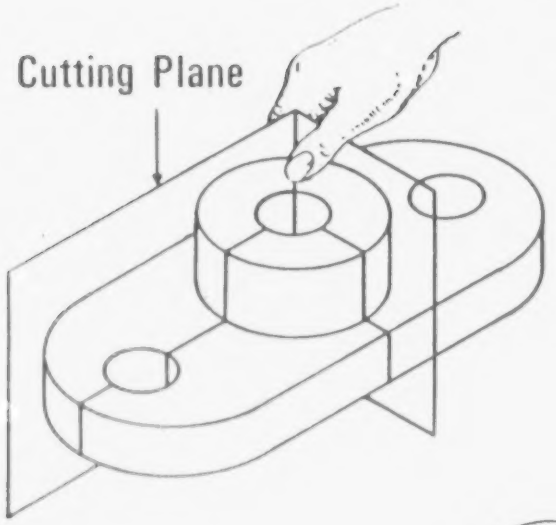


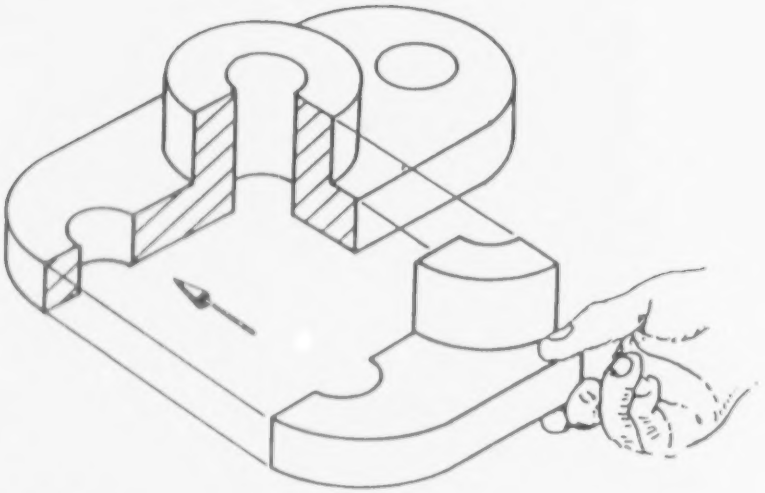


Front View

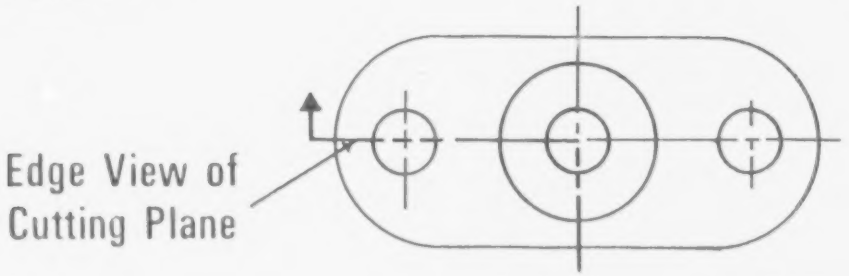
TM 1.1

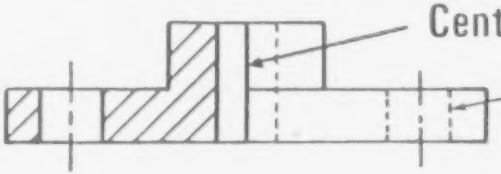
Half Section



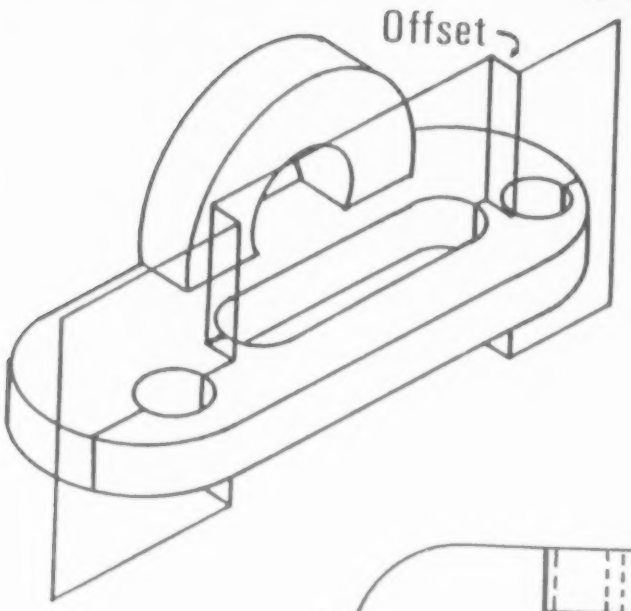


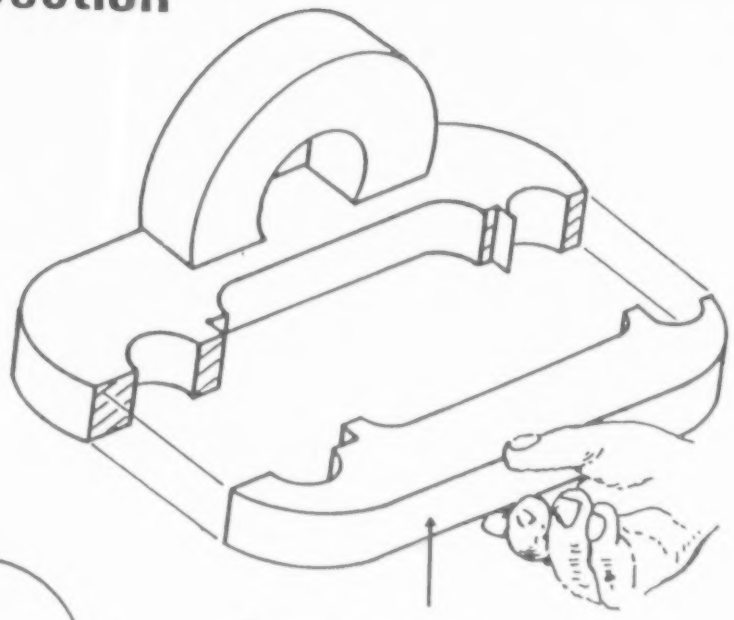
Remove One Quarter



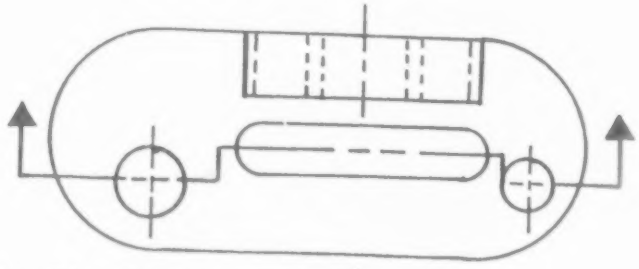


Offset Section



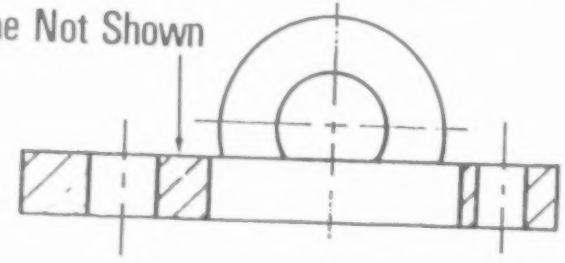


Removed Portion



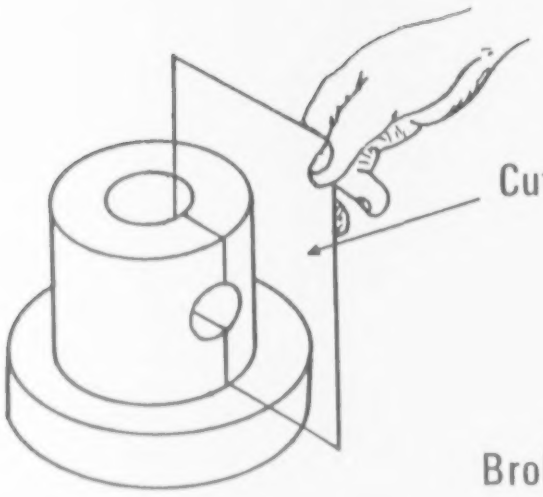
Top View

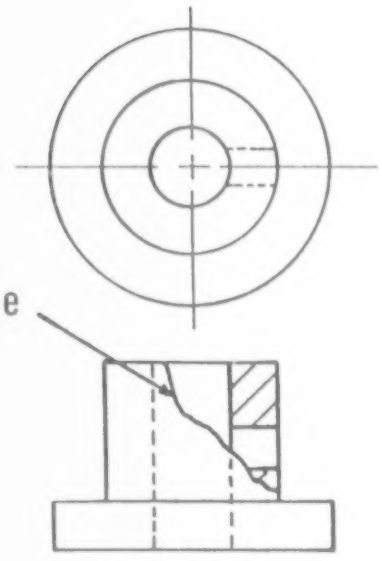
Offset Line Not Shown

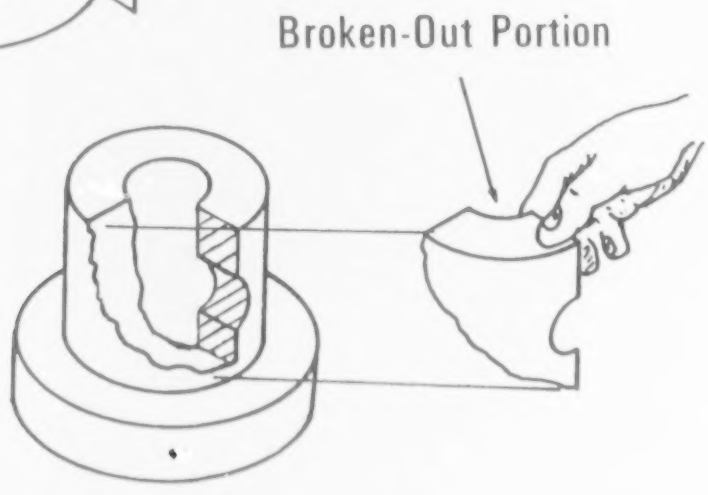


Front View

Broken-Out Section





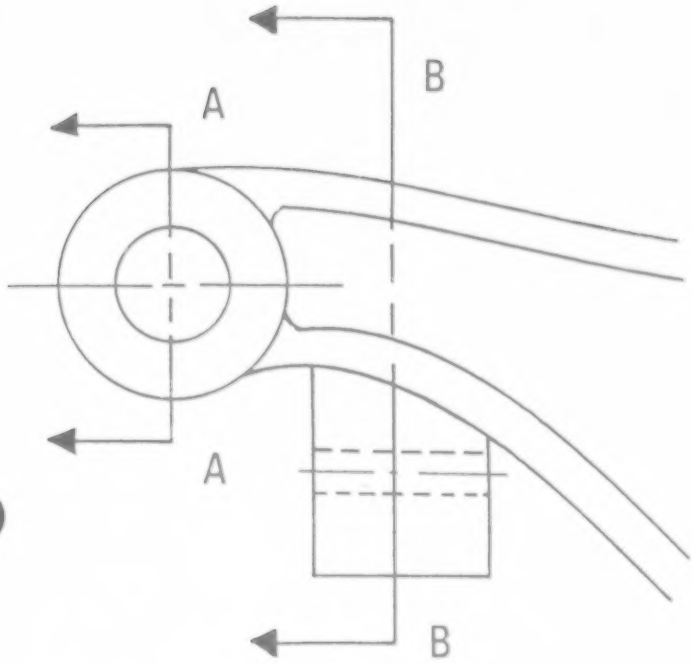


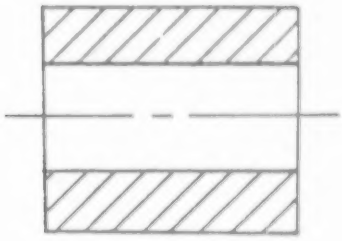
Front View with
Broken-Out Section

TM 1.4

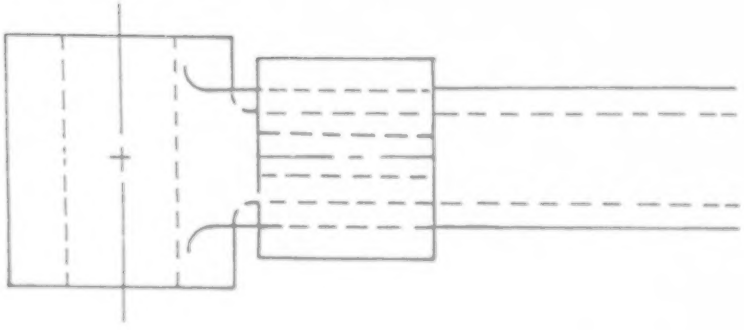
TM 1.5

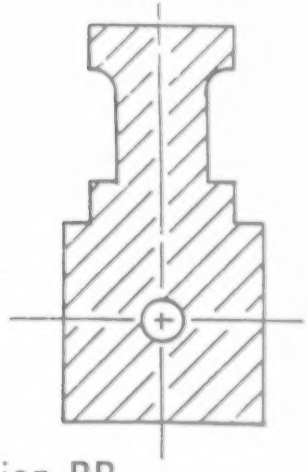
Removed Section





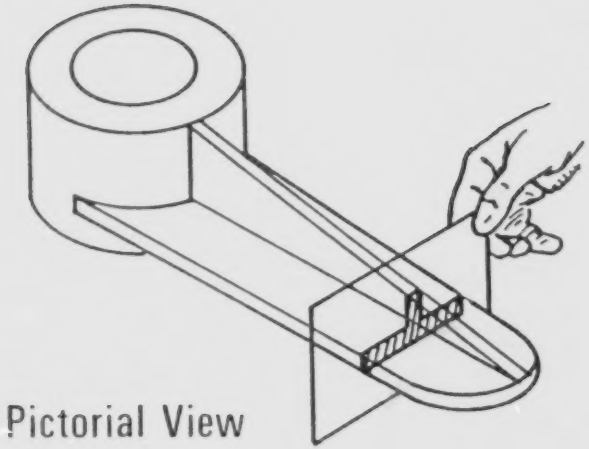
Section AA





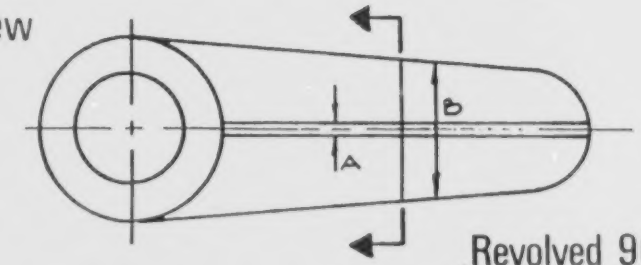
Section BB

Revolved Section

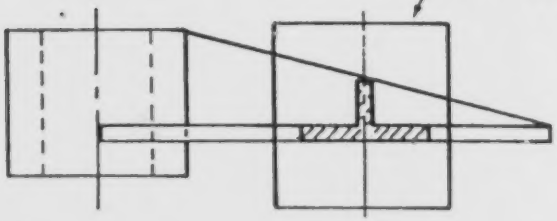


Pictorial View

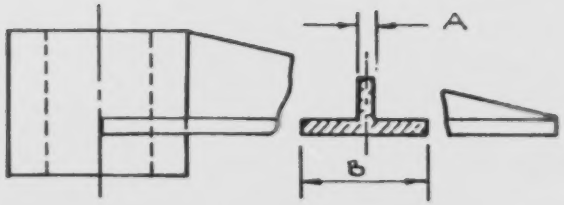
Top View



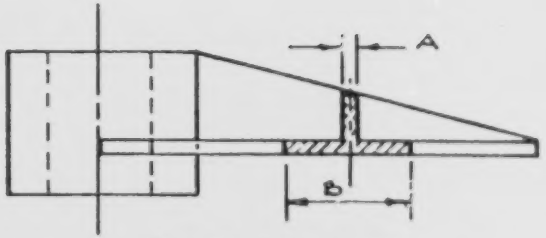
Revolved 90°



Front View



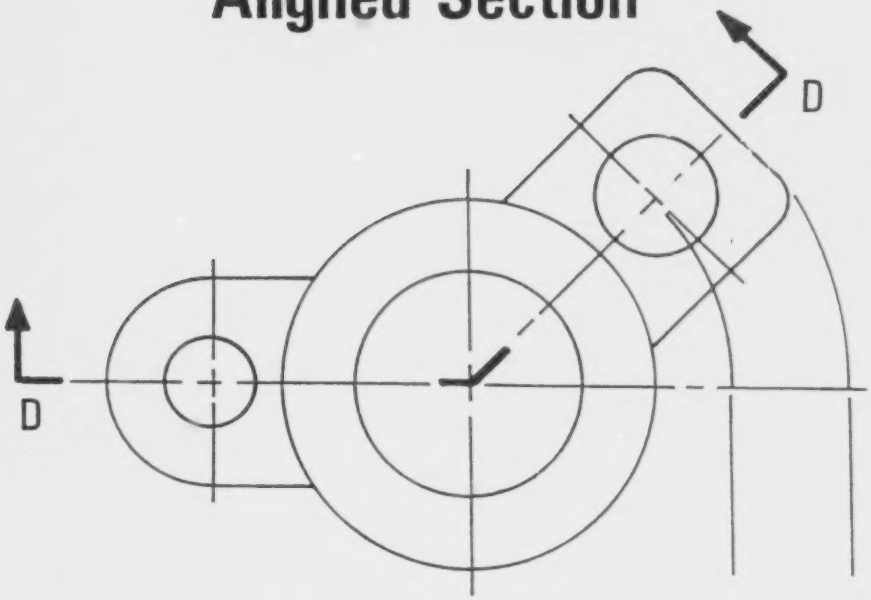
Broken Around Section

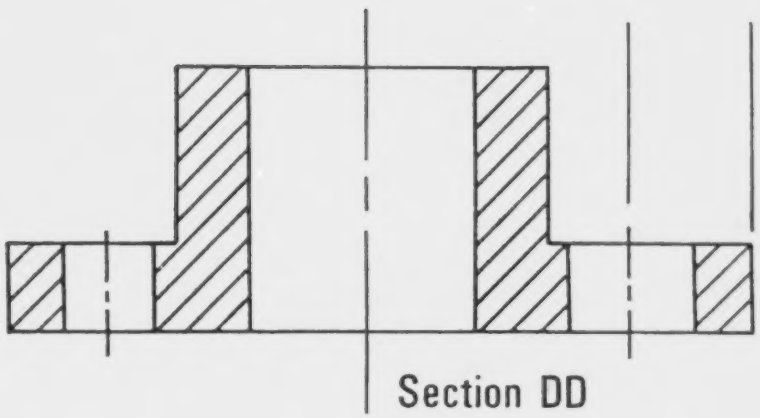


Section in View

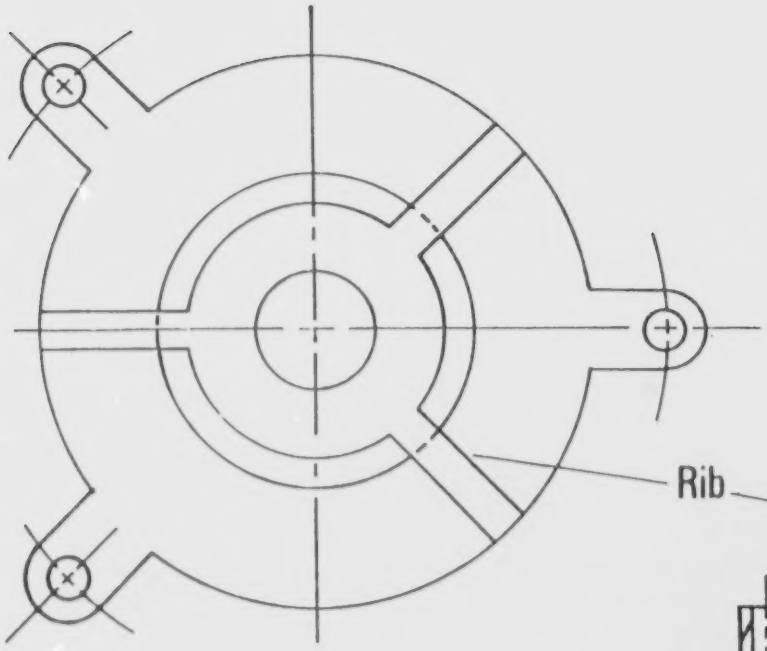
TM 1.6

Aligned Section

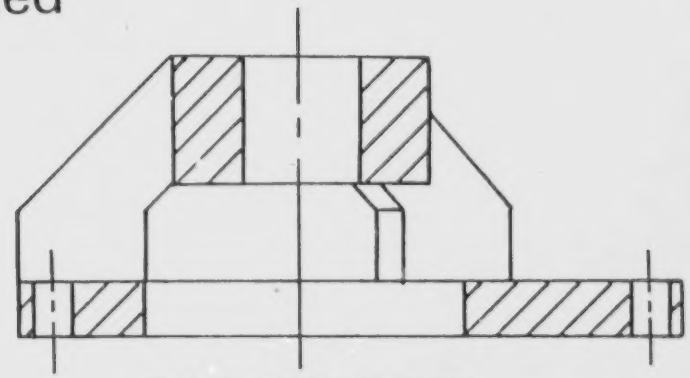




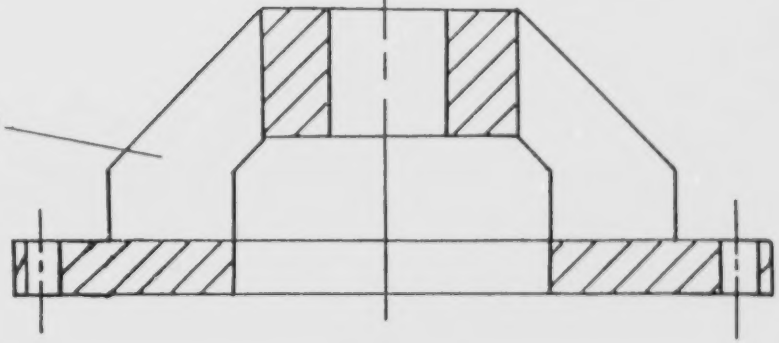
Aligned Section
Continued



Rib



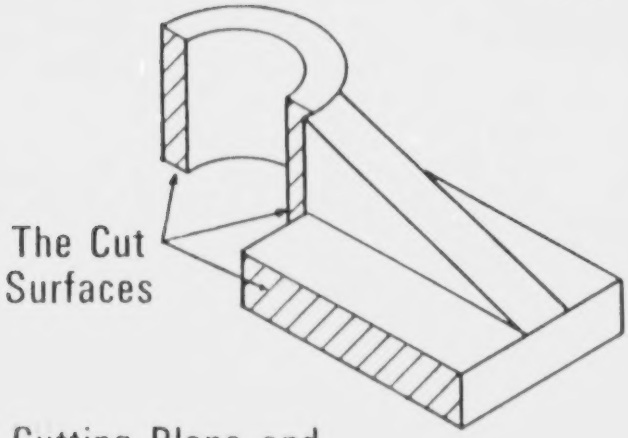
TRUE PROJECTION



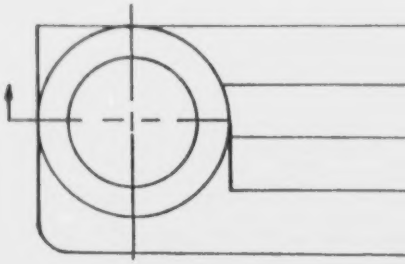
PREFERRED

TM 1.8

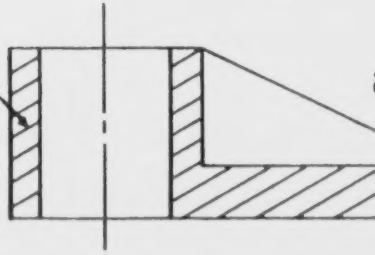
Rib Secti



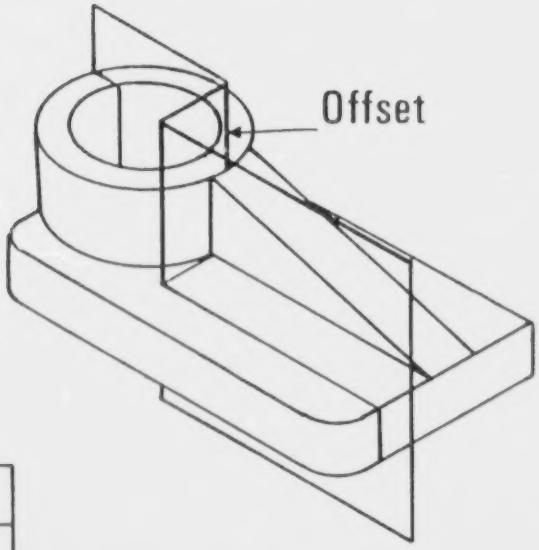
Cutting Plane and
Front Part Removed

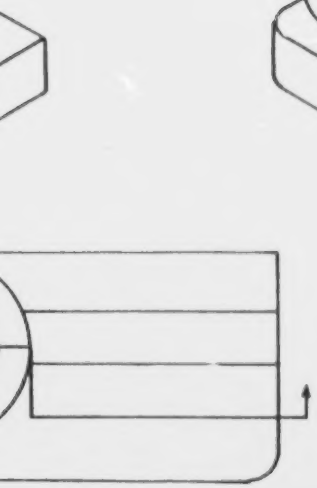


Omit Hidden Line

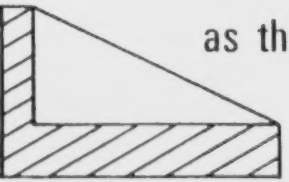


ib Section



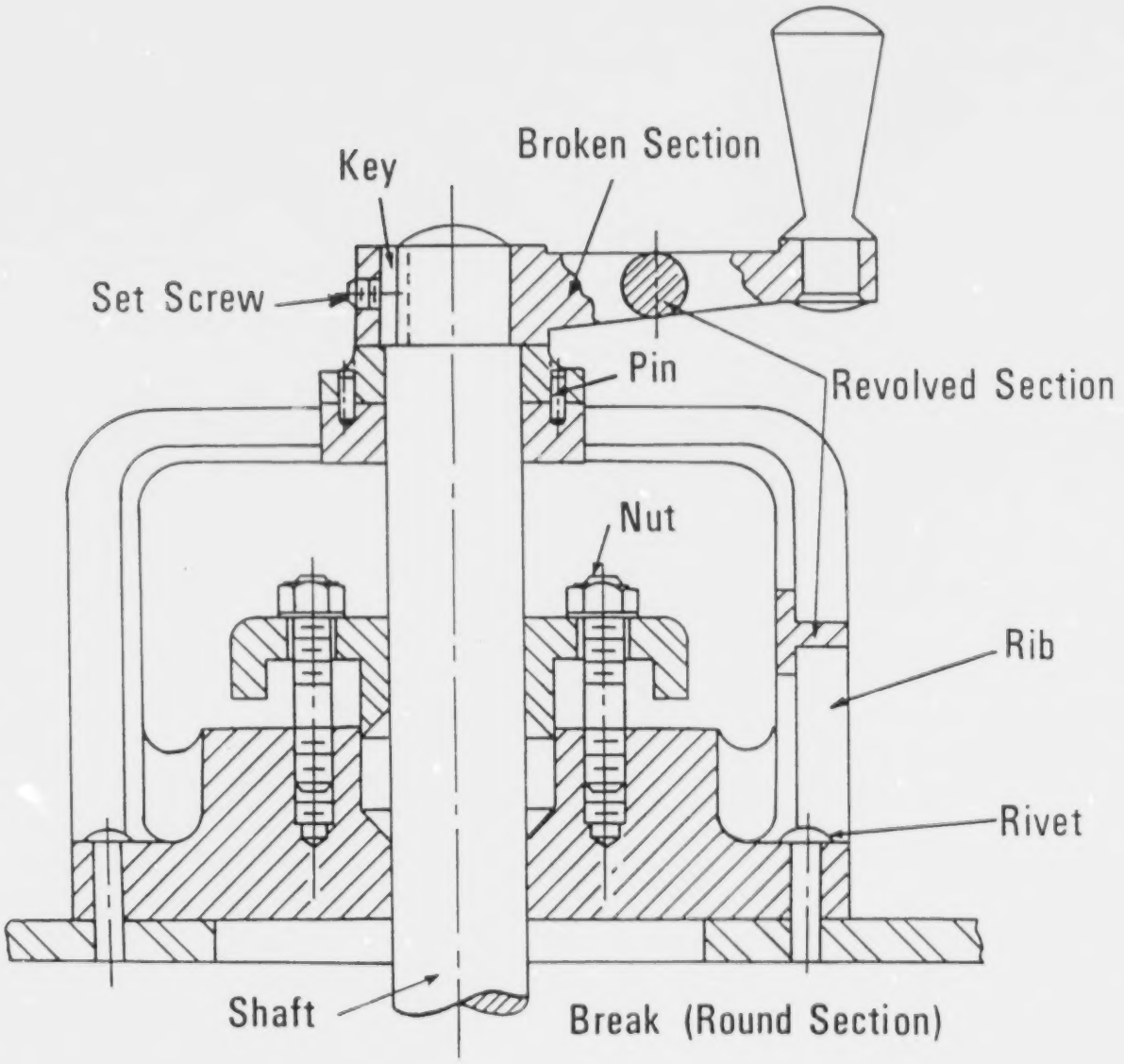


Do Not project offset but show as though a continuous full section.

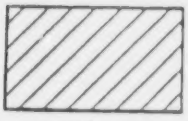


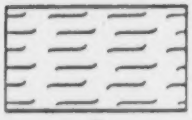
TM 1.9

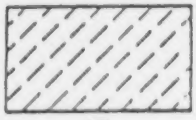
Assembly Section

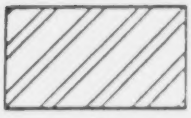


Material Symbols in Section


Cast or malleable iron and general use for all materials
1

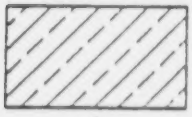

Cork, felt, fabric, leather, and fiber
7

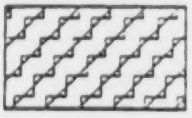

Marble, slate, glass porcelain, etc.
13


Steel
2

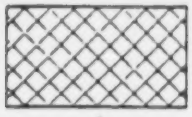
Sound insulation
8

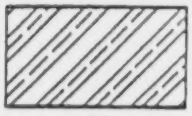
Earth
14

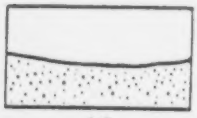

Bronze, brass, copper, and compositions
3

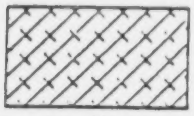

Thermal insulation
9

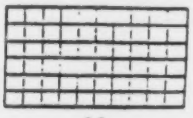
Rock
15

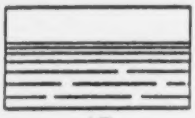

White metal, zinc, lead, babbitt, and alloys
4

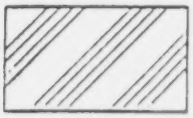

Titanium and refractory material
10

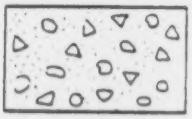

Sand
16


Magnesium, aluminum, and aluminum alloys
5


Electric windings, electromagnets, resistances, etc.
11

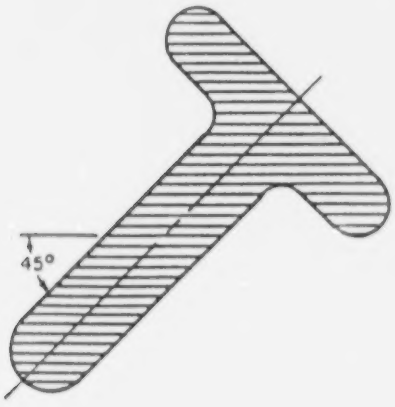

Water and other liquids
17


Rubber, plastic, and electrical insulation
6

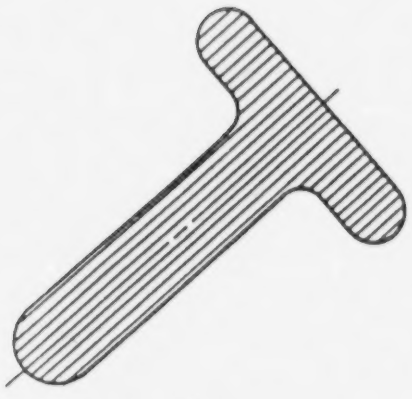

Concrete
12

18

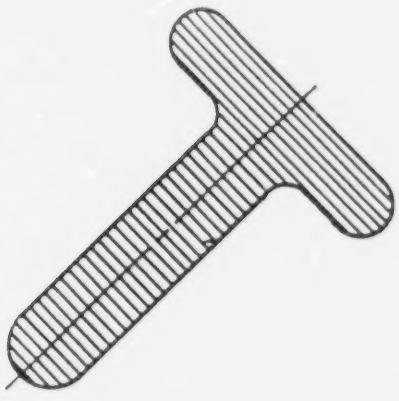
Direction of Section Lines



Correct

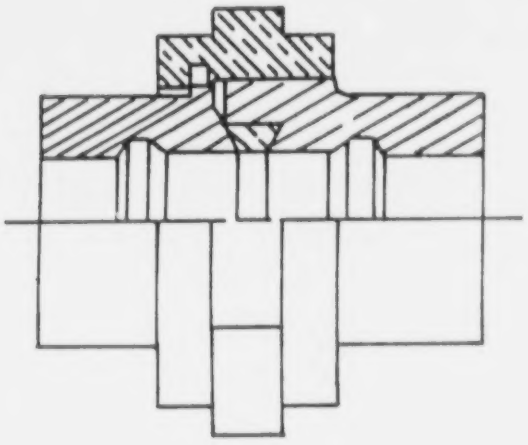


Incorrect

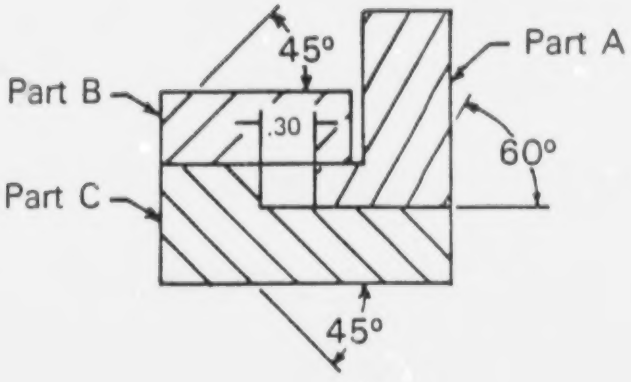


Incorrect

Materials in Assembly Section

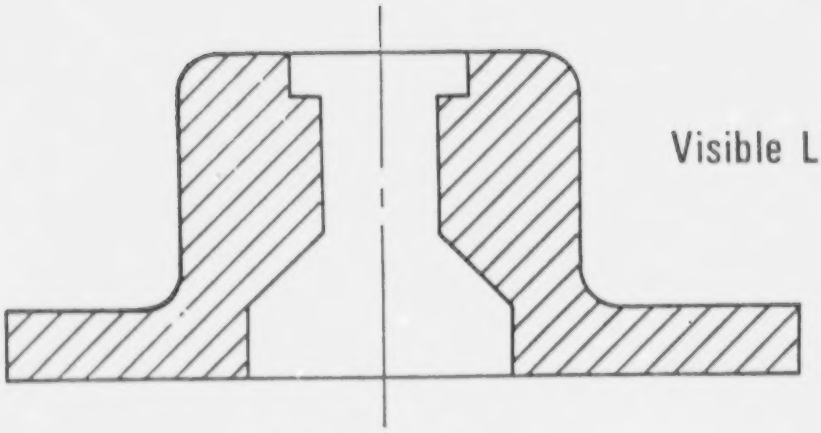


Materials in Section



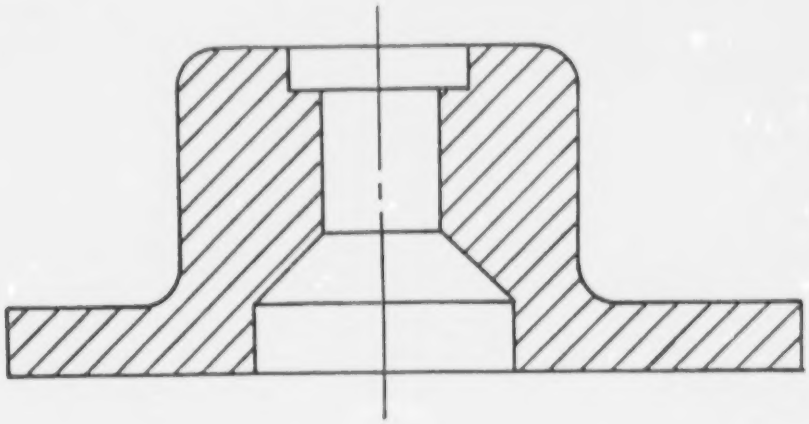
Adjacent Parts

Visible Lines



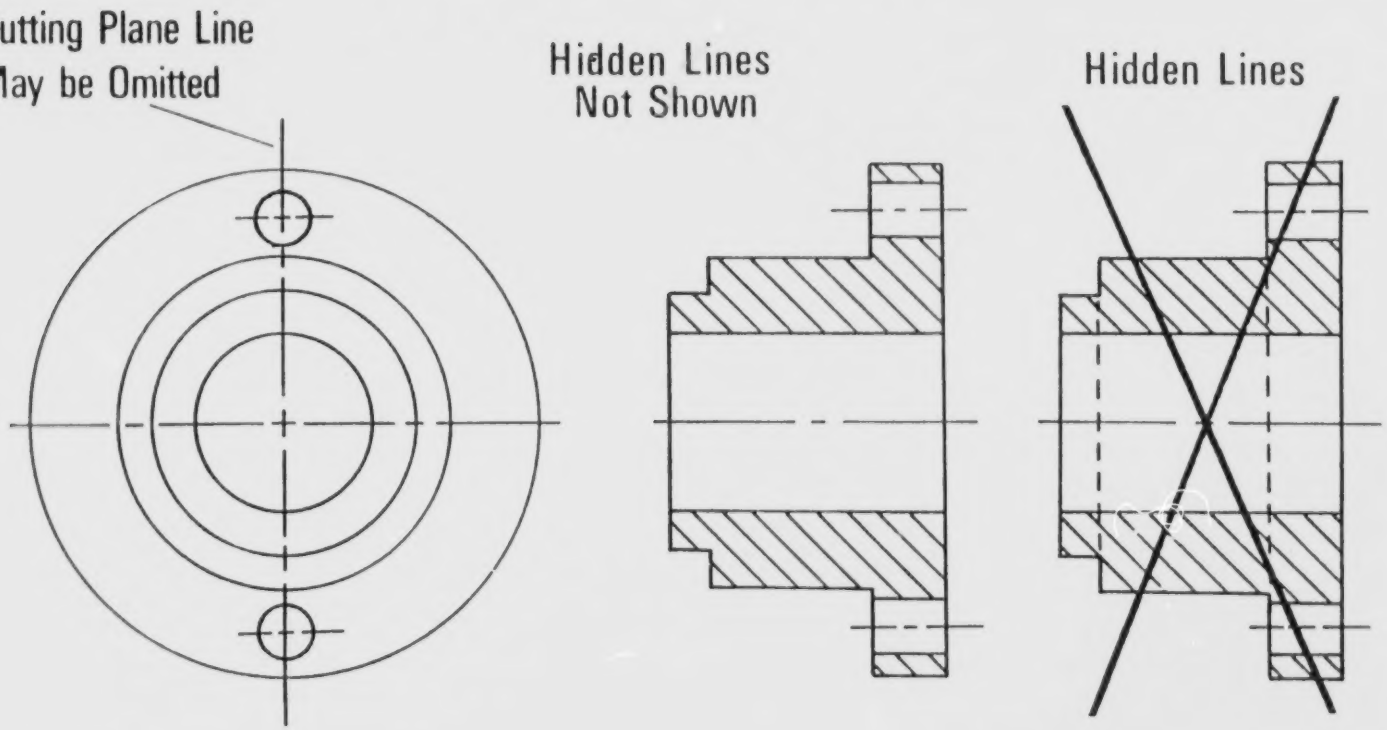
Visible Lines Omitted

INCORRECT



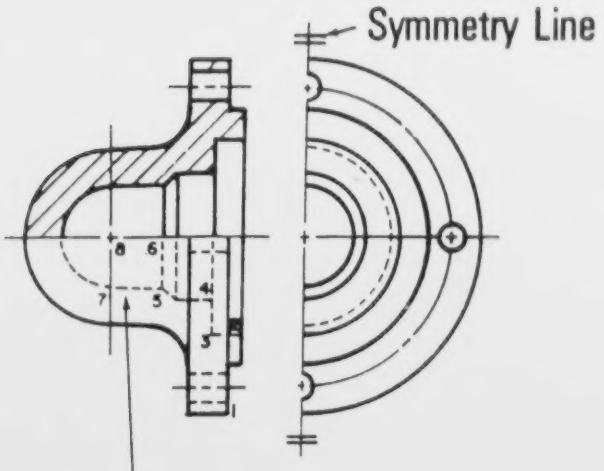
CORRECT

Hidden Lines

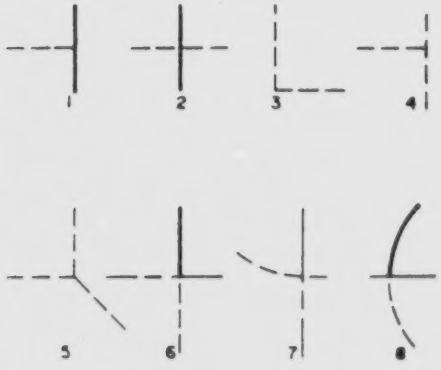


TM 1.15

Hidden and Symmetry Line Application

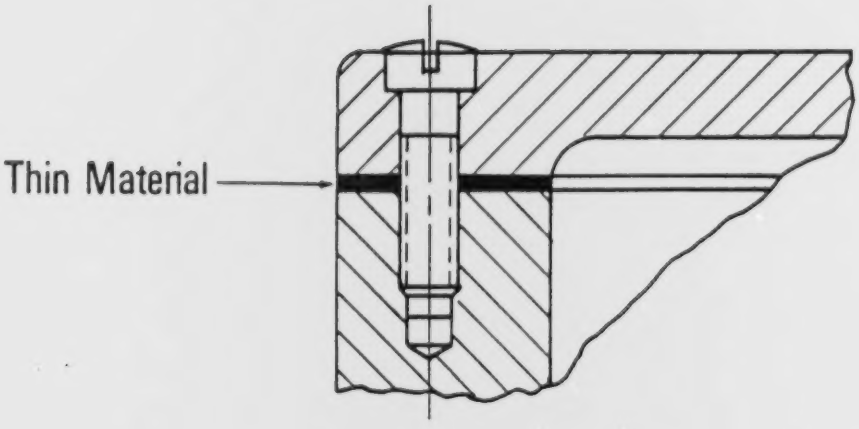


Enlarged Details



Thin Sections

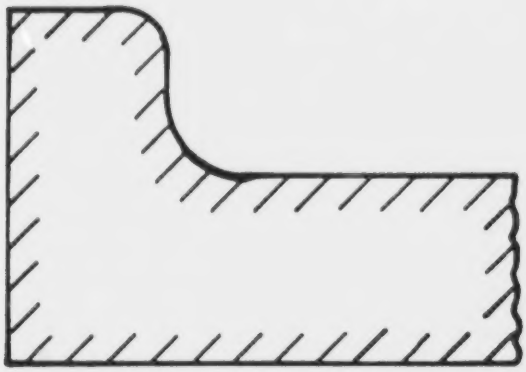
Structural Shapes



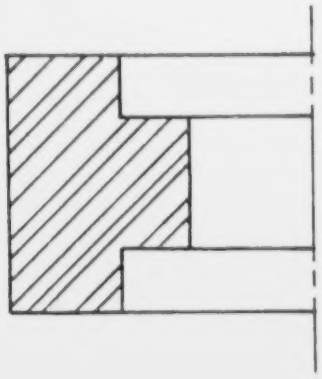
Gasket

TM 1.18

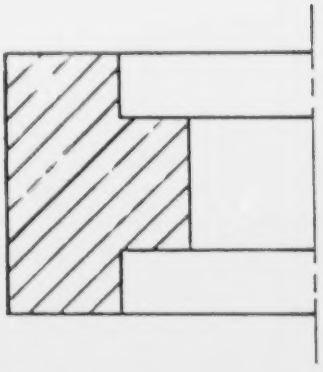
Outline Section



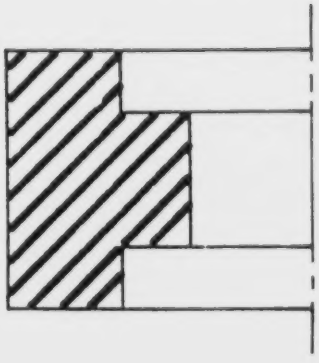
Errors in Making Section Lines



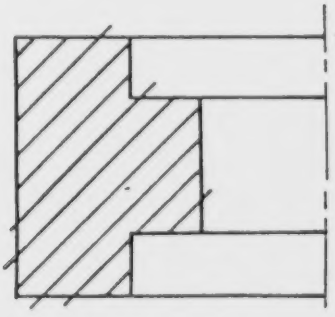
Uneven Spacing



Uneven Line Weight

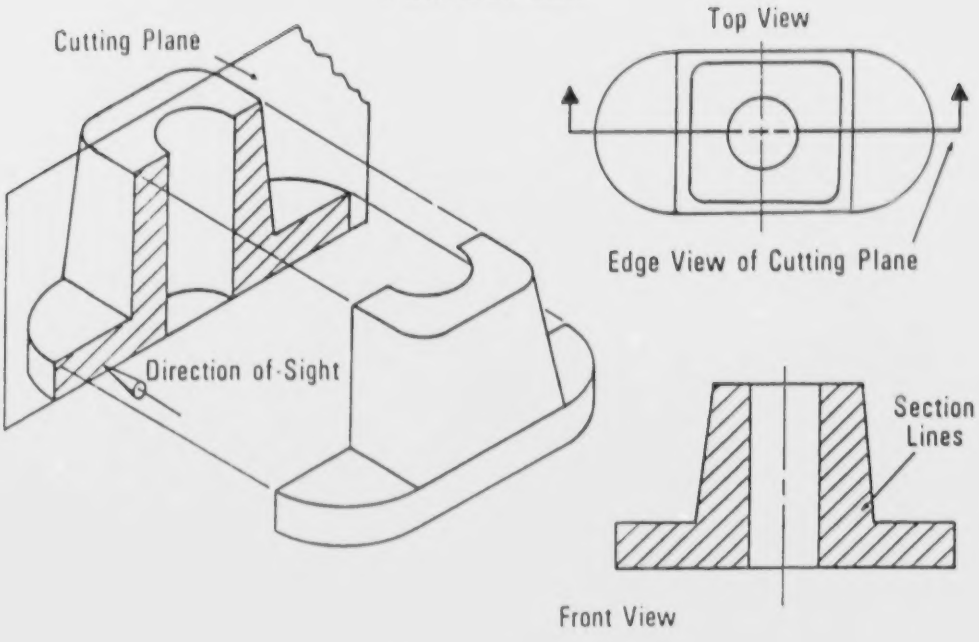


Lines Too Thick

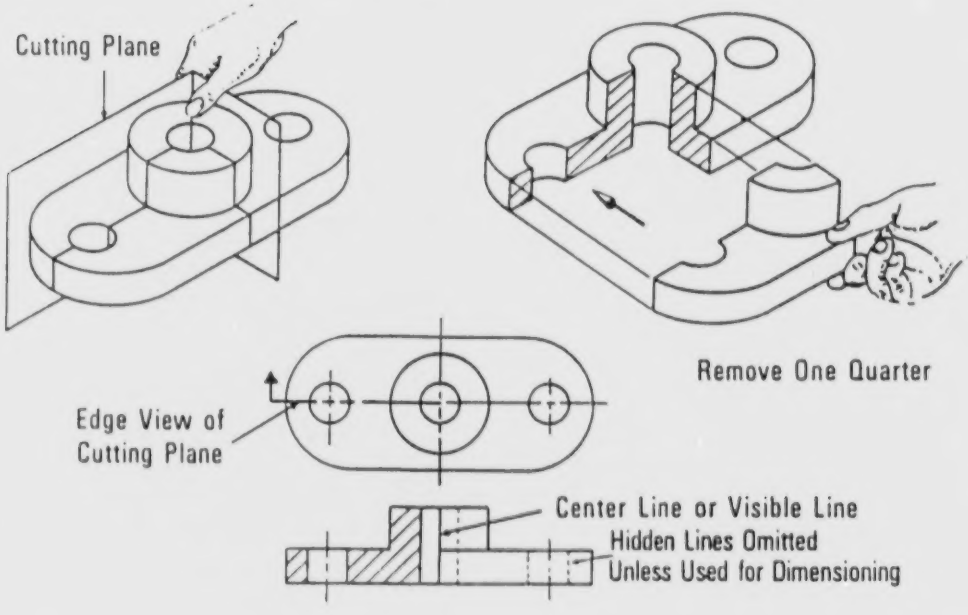


Overrun Lines

Full Section

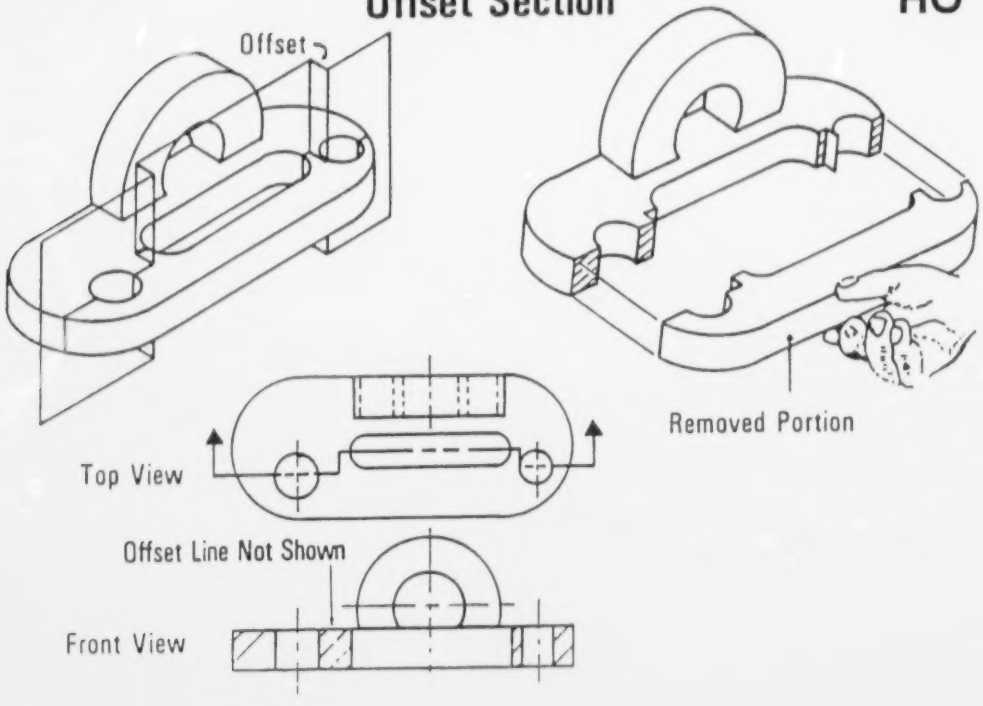


Half Section

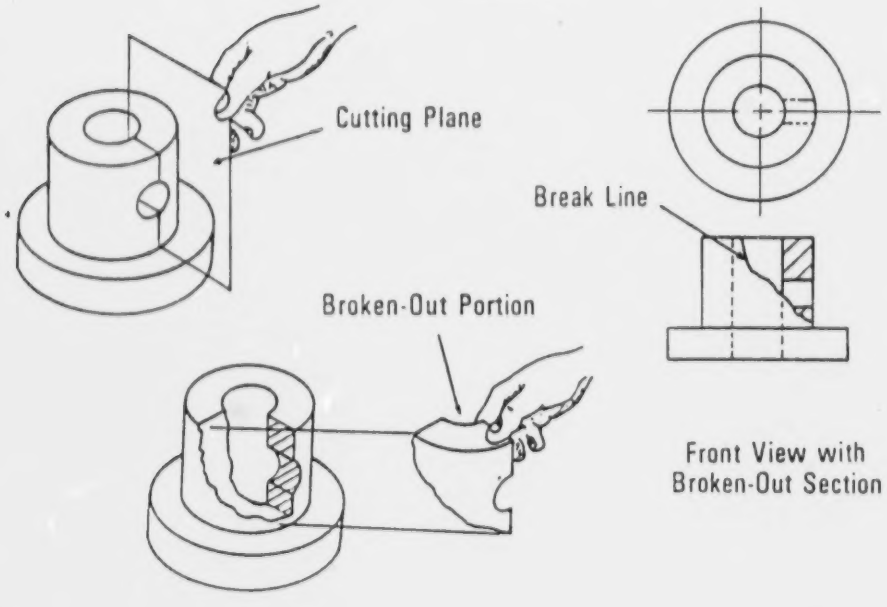


Offset Section

HO 1.2

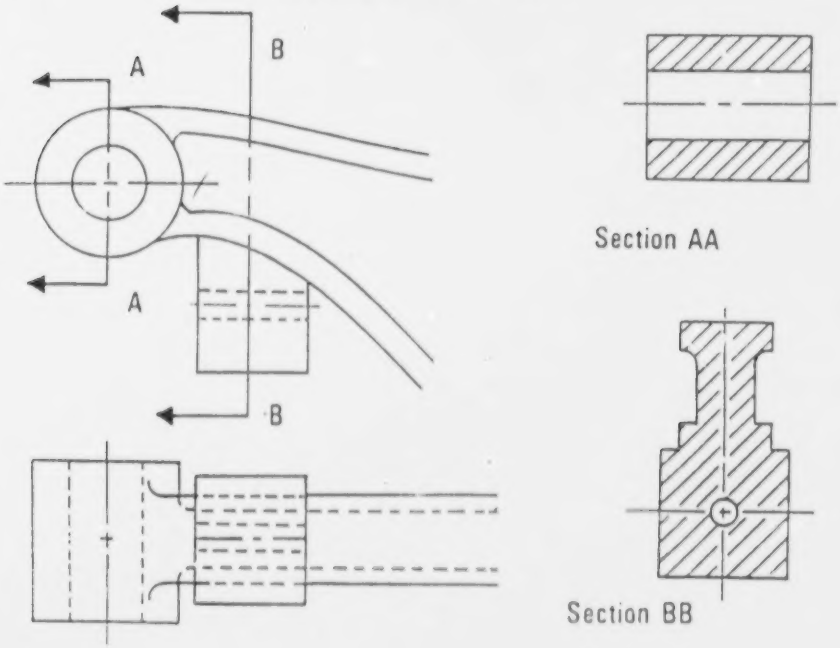


Broken-Out Section

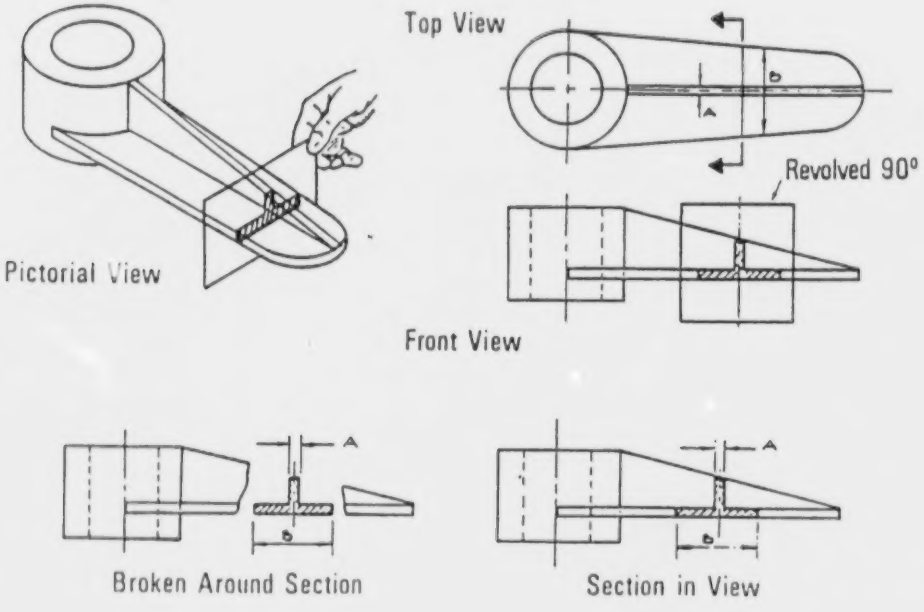


Removed Section

HO 1.3

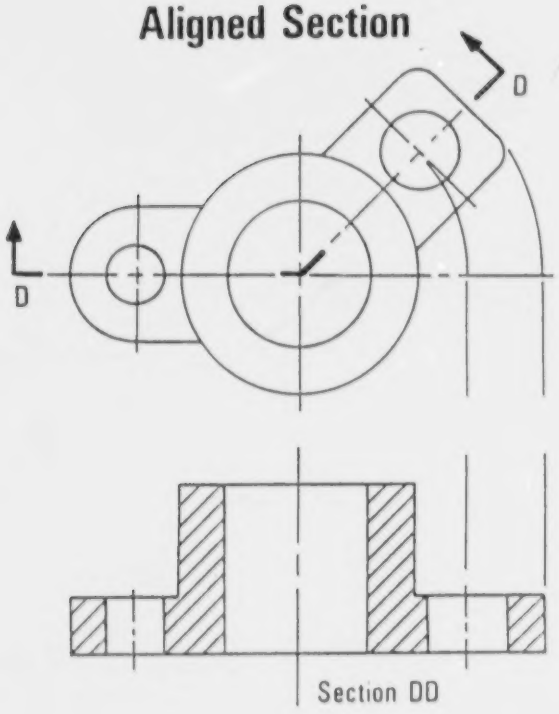


Revolved Section

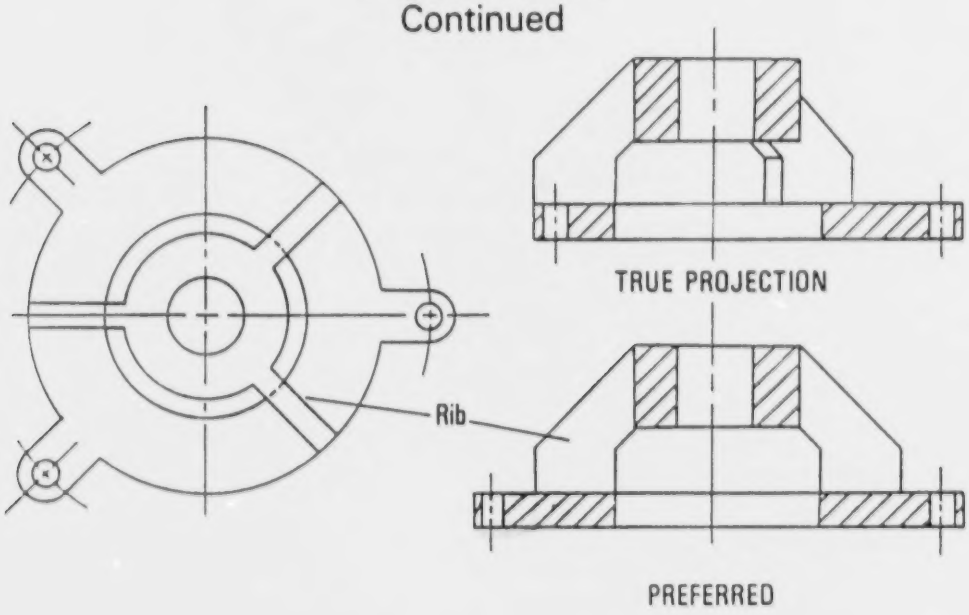


HO 1.4

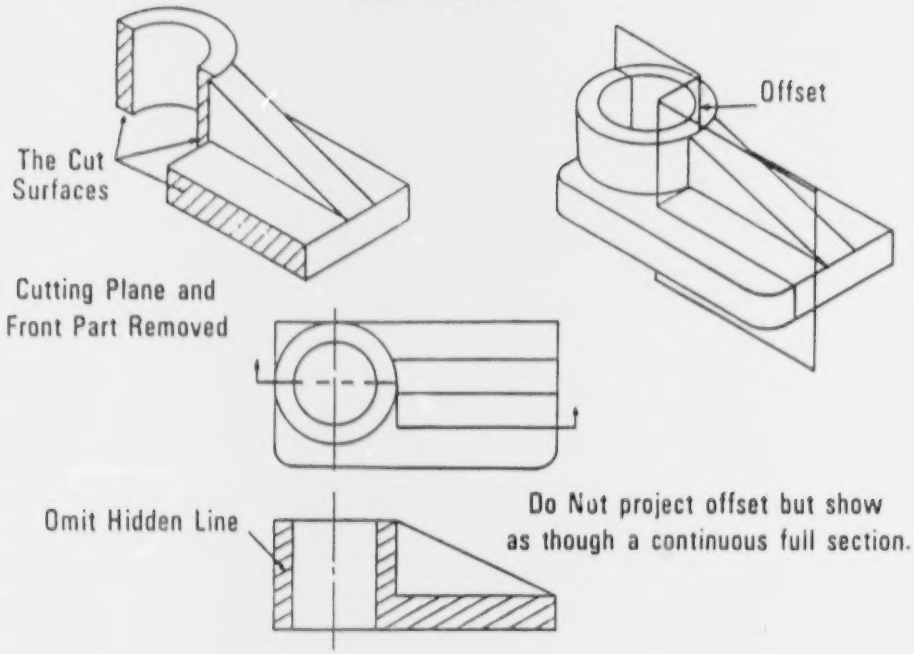
Aligned Section



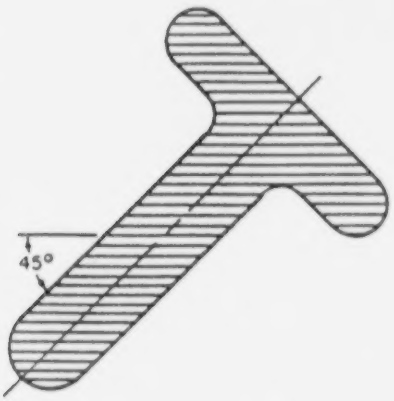
Aligned Section
Continued



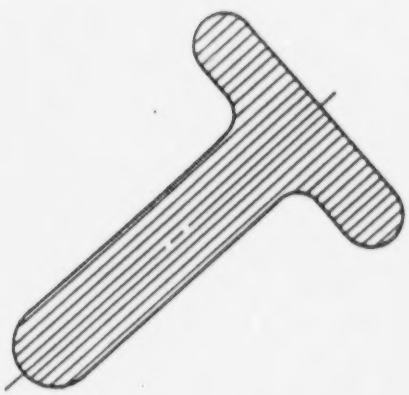
Rib Section


The Cut Surfaces
Offset
Cutting Plane and Front Part Removed
Omit Hidden Line
Do Not project offset but show as though a continuous full section.

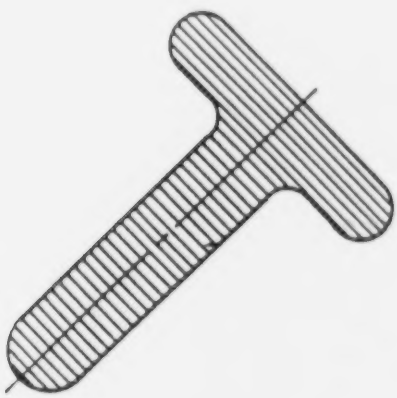
Direction of Section Lines



Correct



Incorrect



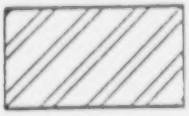
Incorrect

HO 1.7

Material Symbols in Section

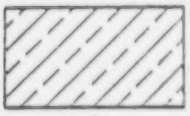
Cast or malleable iron and general use for all materials

1



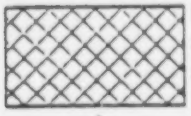
Steel

2



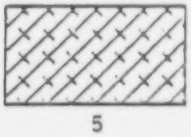
Bronze, brass, copper, and compositions

3



White metal, zinc, lead, babbitt, and alloys

4

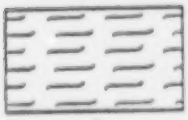


Magnesium, aluminum, and aluminum alloys

5

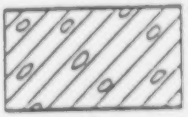
Rubber, plastic, and electrical insulation

6



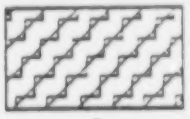
Cork, felt, fabric, leather, and fiber

7



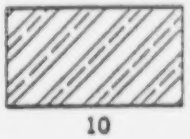
Sound insulation

8



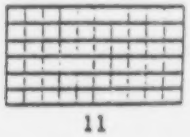
Thermal insulation

9



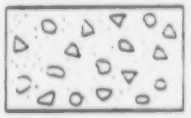
Titanium and refractory material

10



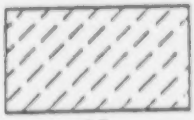
Electric windings, electromagnets, resistances, etc.

11



Concrete

12



Marble, slate, glass porcelain, etc.

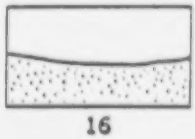
13

Earth

14

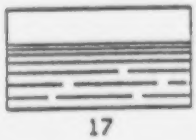
Rock

15



Sand

16



Water and other liquids

17

Across grain

With grain

WOOD

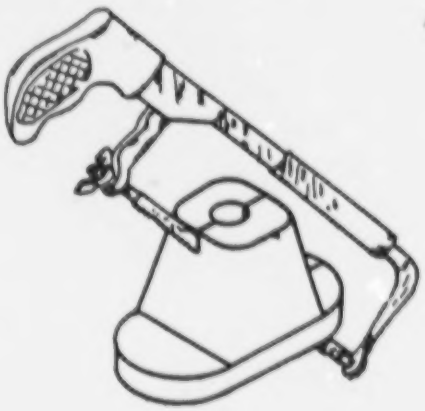
18

CONSTRUCT A FULL SECTION OF AN OBJECT

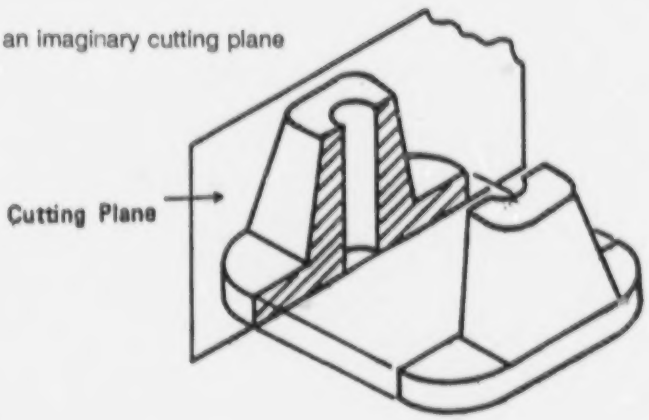
Premise: A full section view of an object can be constructed by using the procedure in the following example.

Example:

1. Imagine cutting an object all the way across with a hacksaw

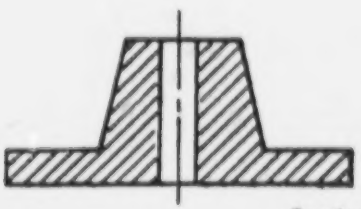


2. Think of the saw cut as an imaginary cutting plane

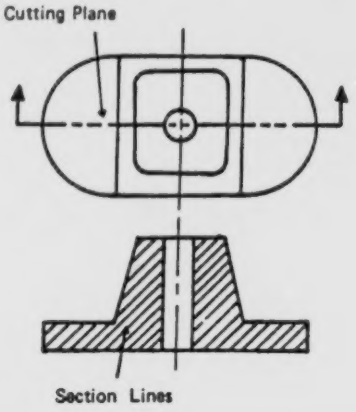


3. With the front half removed, visualize what the front view would look like

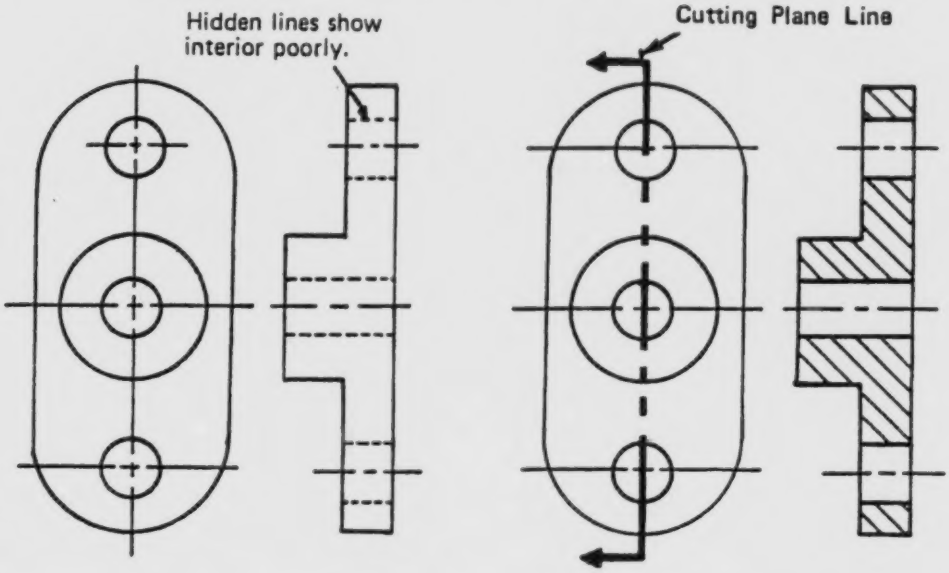
NOTE: This is a full section.



4. On a drawing you would show the complete top view and its cutting plane line; the area actually cut by the hacksaw would be represented with section lines

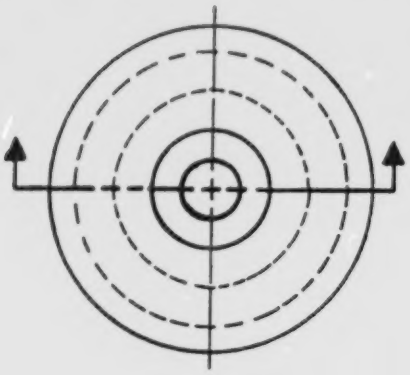


5. On an actual drawing, the two views would be drawn lightly as in orthographic projection with hidden lines, etc; then the drafter would visualize the internal features of the object and draw that view in section omitting hidden lines

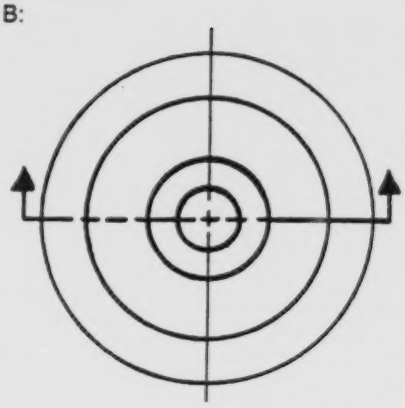


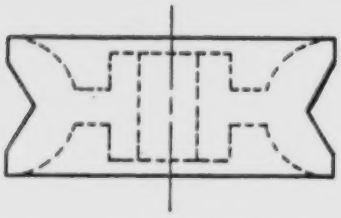
Directions: Change the front view of objects below to full section views.

Problem A:

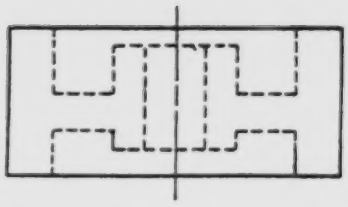


Problem B:



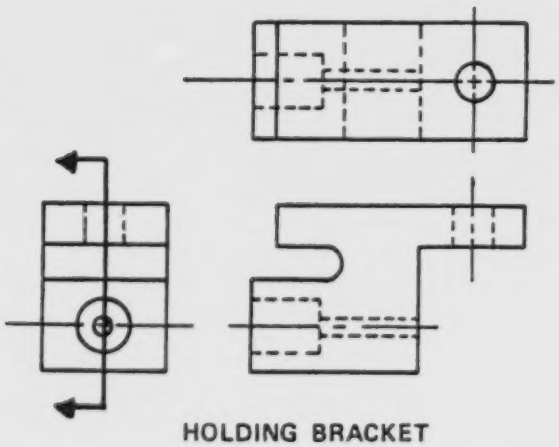


V PULLEY



BELT DRIVE

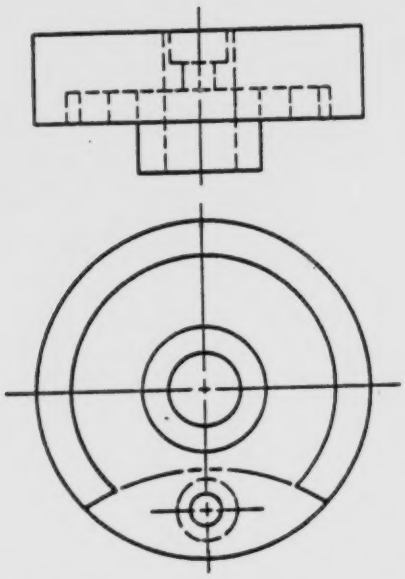
Problem C:



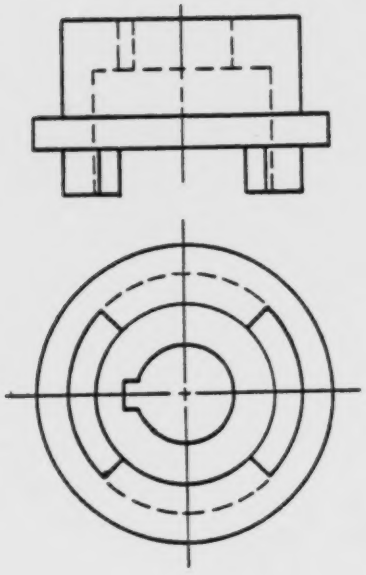
HOLDING BRACKET

Directions: Complete the right side views of the following problems to full section views.

Problem D:



Problem E:

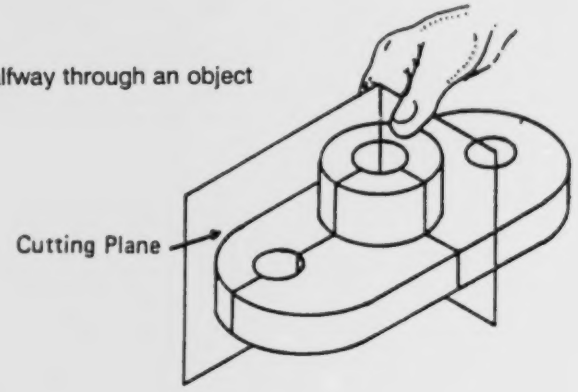


CONSTRUCT A HALF SECTION OF AN OBJECT

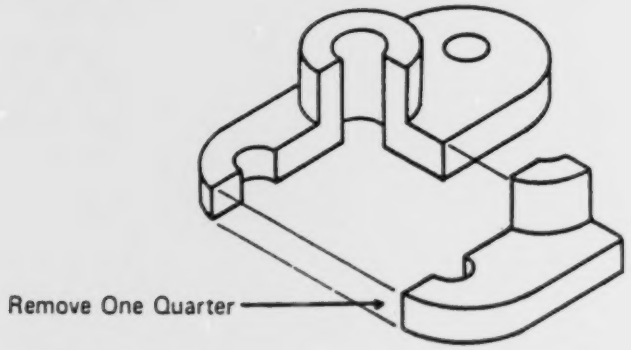
Premise: A half section view of an object can be constructed by using the procedure in the following example.

Example:

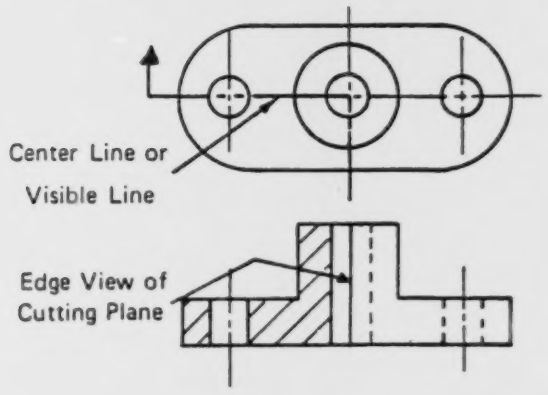
1. Think of an imaginary plane cutting halfway through an object



2. Remove that section and assume a line of sight looking into the area cut by the plane

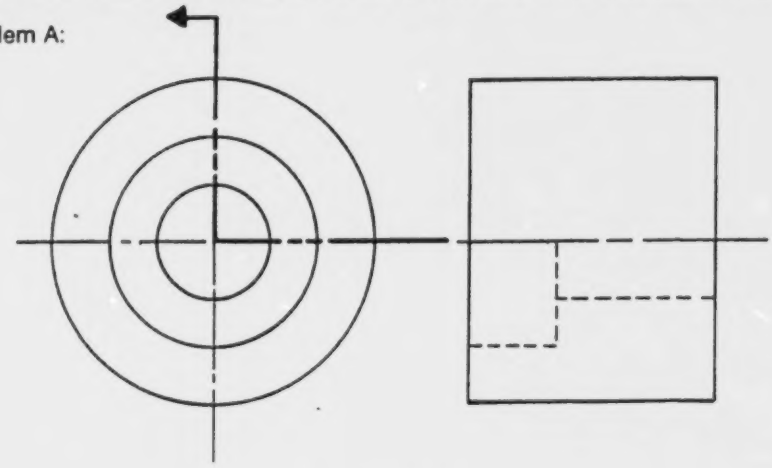


3. Construct top view with a cutting plane line that passes halfway through the object; project lines to front view and determine areas to be sectioned



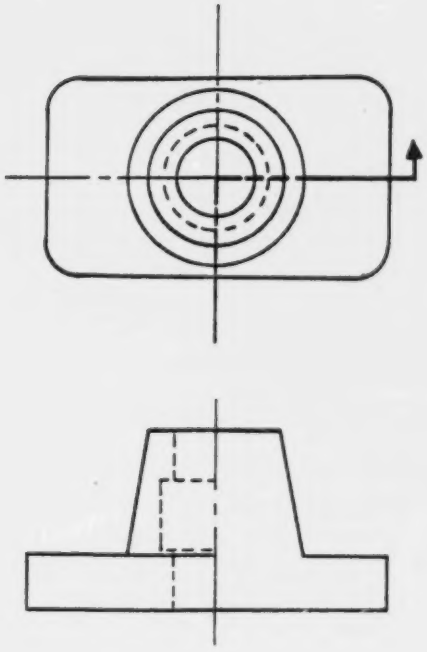
Directions: Construct section lines in the part of the view behind the cutting plane line.

Problem A:



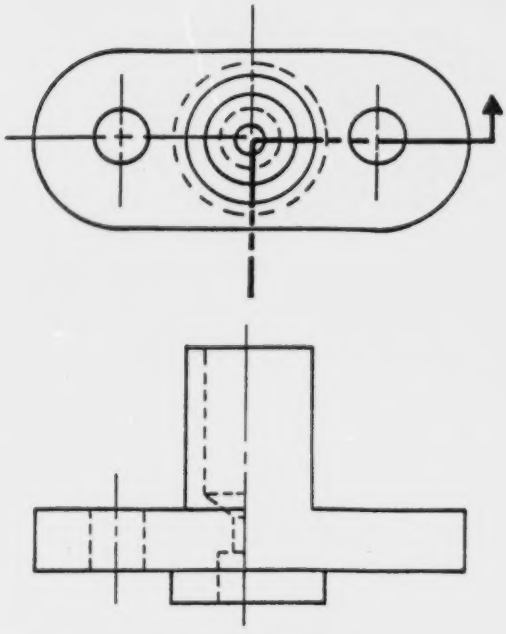
BUSHING

Problem B:



BRACKET BASE

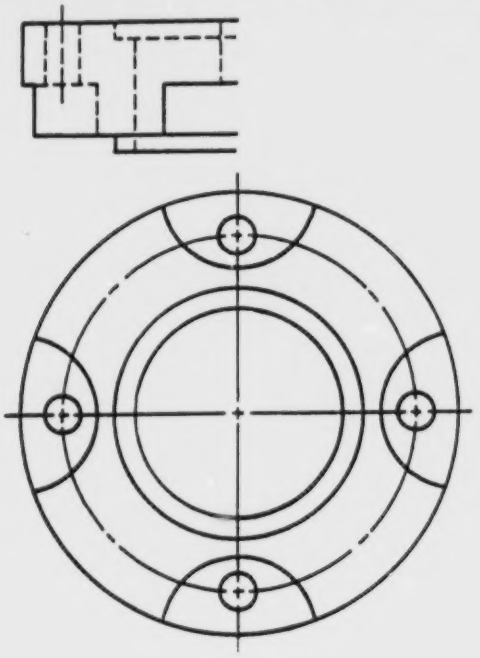
Problem C:



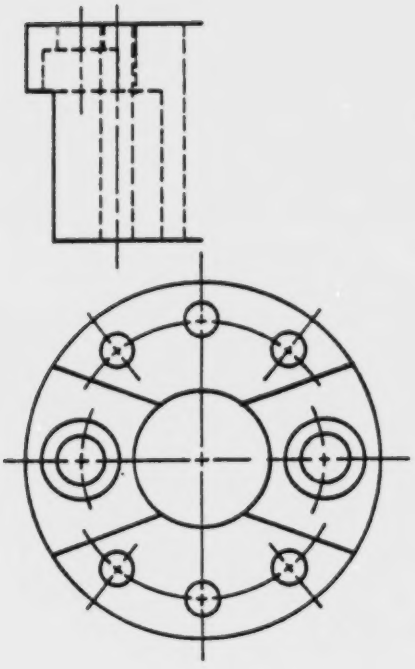
SHAFT SUPPORT

Directions: Complete top views for the following problems to half sections.

Problem D:



Problem E:

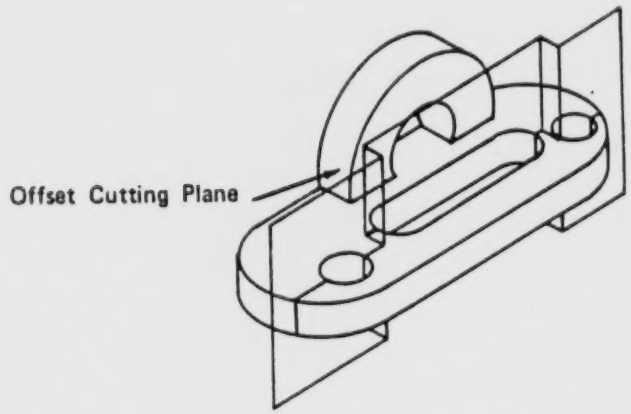


CONSTRUCT AN OFFSET SECTION OF AN OBJECT

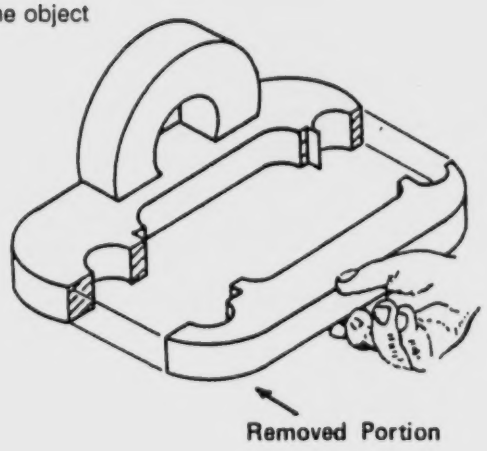
Premise: An offset section of an object can be constructed by using the procedure in the following example.

Example:

1. Decide which features about this object are not in a common line but should be shown in section

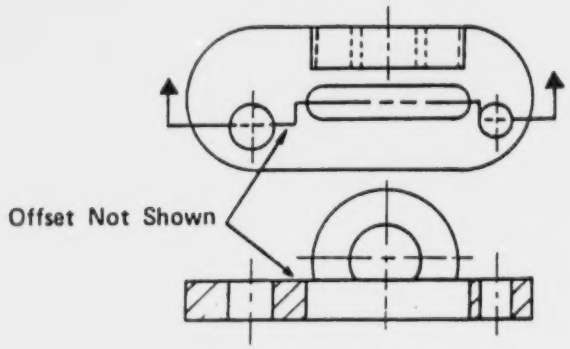


2. Remove the portion in front and look into the object



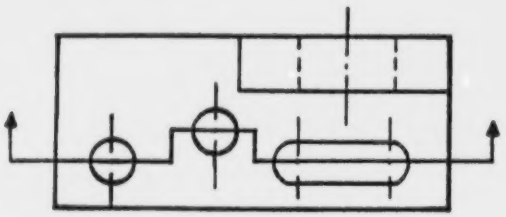
3. A drawing of the top view would show the offset of the cutting plane; the front section view would show the object as if the slot and holes were all on the same center line

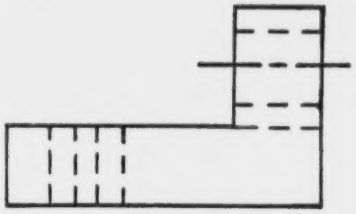
NOTE: The offsets in the cutting plane are not shown with a line in the front section.



Directions: Construct the front view in section.

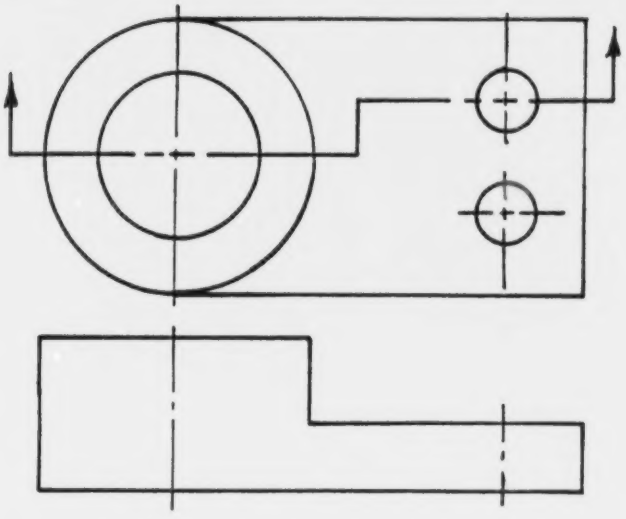
Problem A:





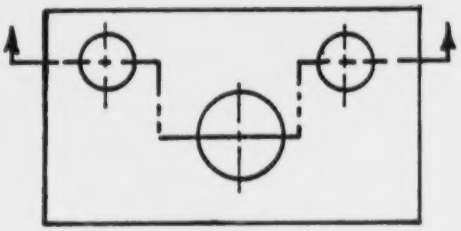
Directions: Complete the front views to offset sections for the following problem.

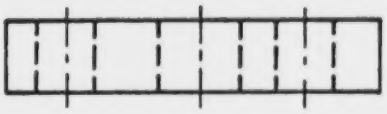
Problem B:



Directions: Construct the cutting plane in top view and complete the front view to an offset section.

Problem C:





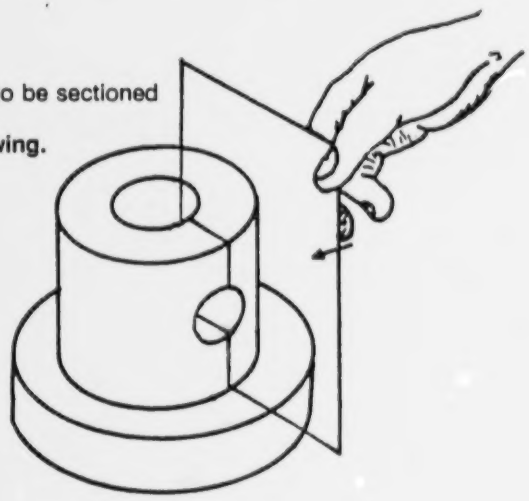
CONSTRUCT A BROKEN-OUT SECTION OF AN OBJECT

Premise: A broken-out section needs to be used only when a portion of the whole object needs to be sectioned. A broken-out section of an object can be constructed by using the procedure in the following example.

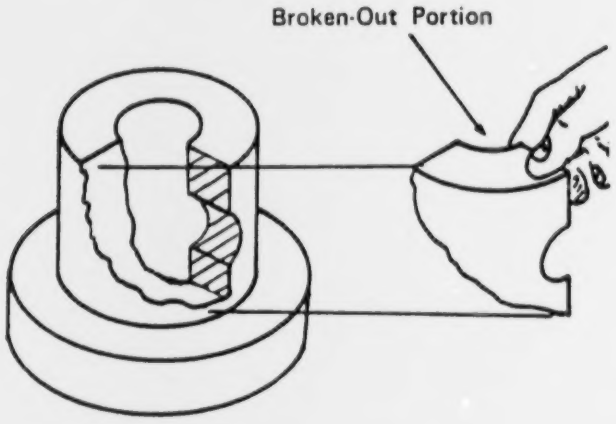
Example:

1. Pass an imaginary cutting plane through the area to be sectioned

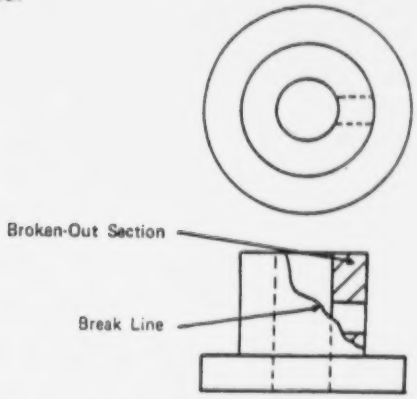
   NOTE: Cutting plane line is not shown on drawing.



2. Remove the portion by breaking it off and visually lifting it out of position

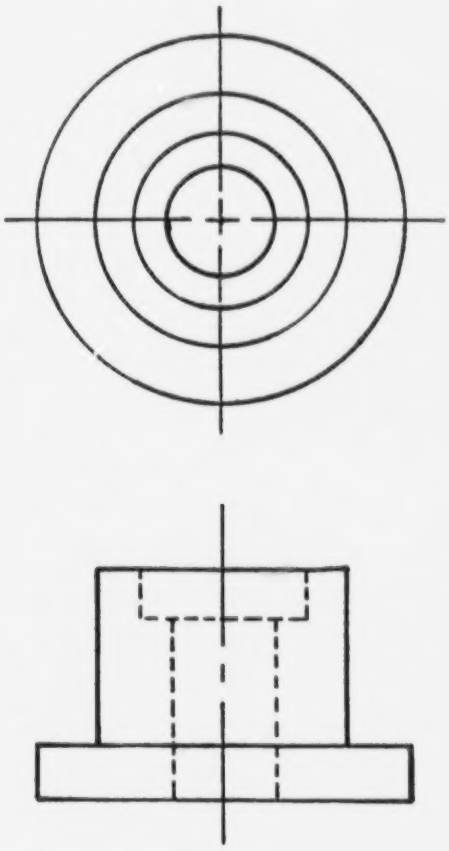


3. On a drawing, the area cut by the plane would appear in section and the broken area would be represented with a short break line; draw the top and front view lightly, then remove the portion that needs to be sectioned.

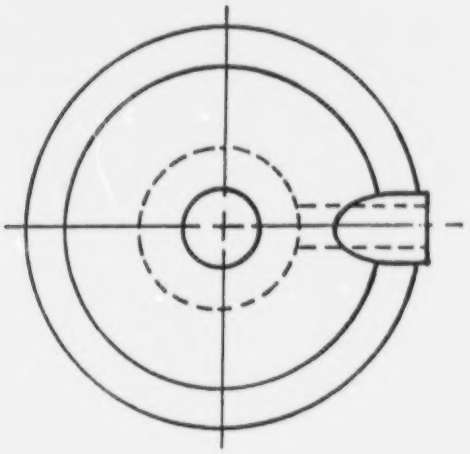


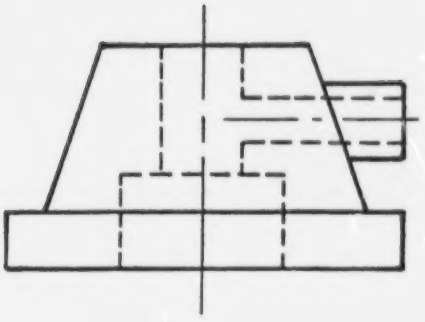
Directions: Construct broken-out sections in front view for the following problems.

Problem A: Bronze material



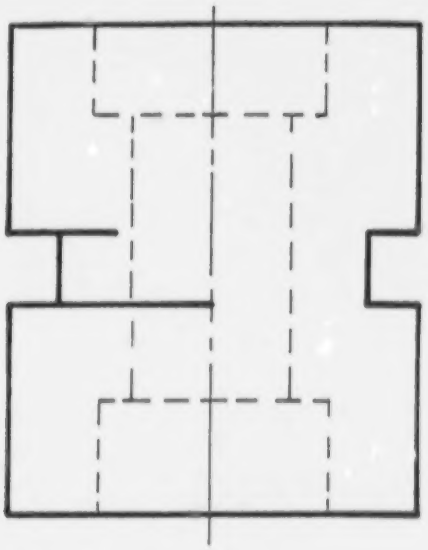
Problem B: Cast iron material





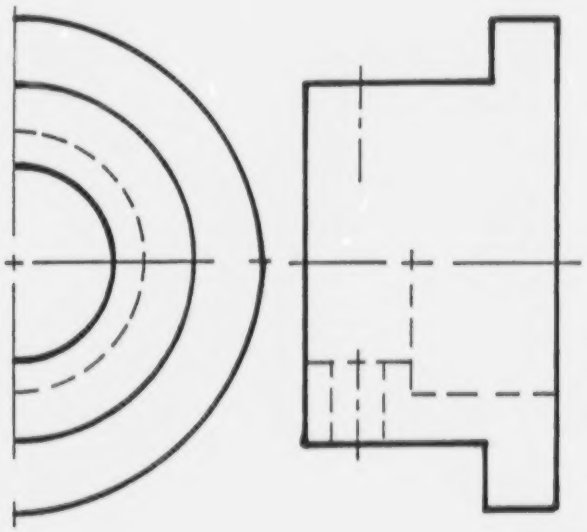
Directions: Construct a broken-out section of the view below.

Problem C: Material as described by instructor



Directions: Construct a broken-out section in right side view.

Problem D: Material as described by instructor



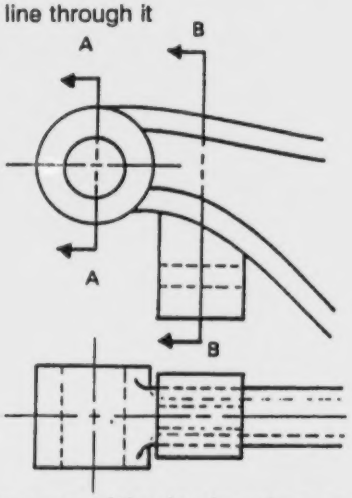
CONSTRUCT A REMOVED SECTION OF AN OBJECT

Premise: A removed section is used to illustrate an area separate from its view by passing an imaginary plane through an area and then drawing it in section and labeling it to correspond to its cutting plane. Removed sections are often used when several sections are taken through one view of an object. A removed section of an object can be constructed by using the procedure in the following example.

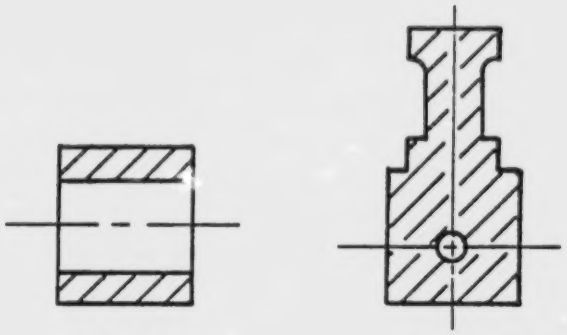
Example:

1. Determine the area to be sectioned and pass a cutting plane line through it

   NOTE: Label the cutting plane lines A-A, B-B, etc.



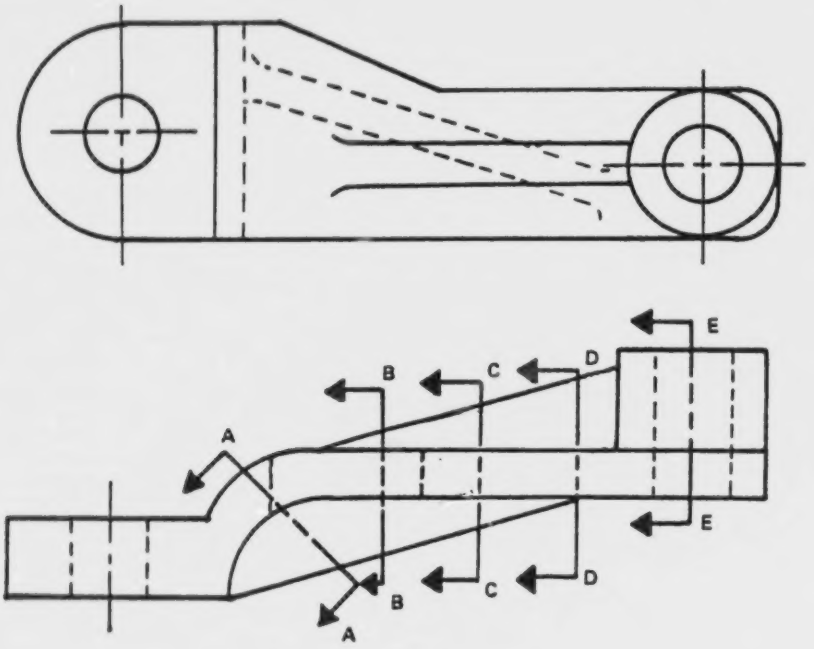
2. Construct the sections indicated by the cutting plane lines on any area of the drawing where space is available but keep axis of section the same as the view it was taken from, if possible

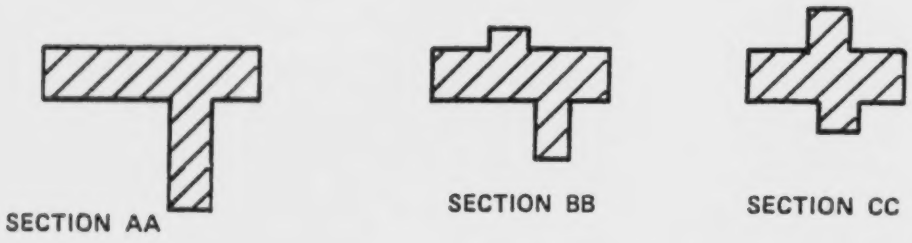


SECTION AA SECTION BB

Directions: Pictured below are two views of an object with a series of sections cut through it. Pictured below it are three of its sections. Complete the other two sections DD and EE. Type of material will be assigned by instructor.

Problem A:



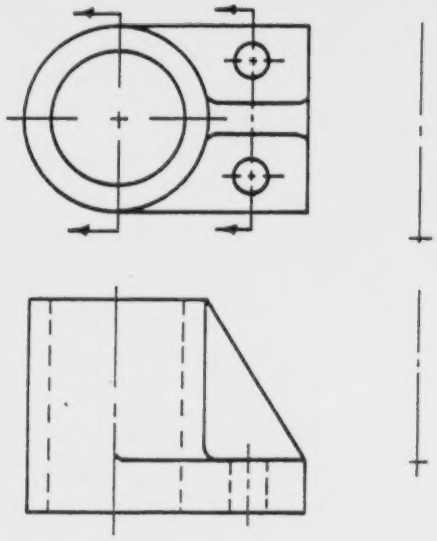


SECTION AA SECTION BB SECTION CC

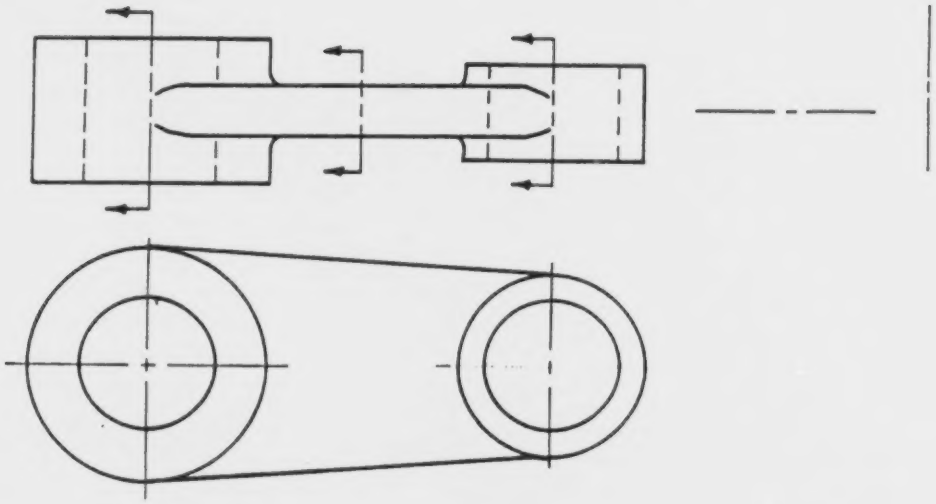
SECTION DD SECTION EE

Directions: Construct the removed sections indicated by cutting plane lines for the following problems. Type of material will be assigned by instructor.

Problem B:



Problem C:

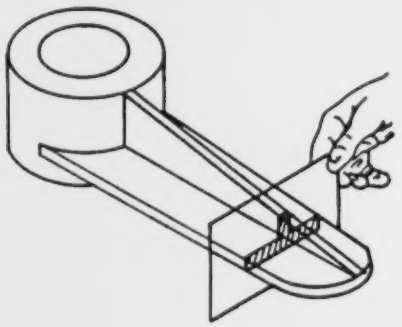


CONSTRUCT A REVOLVED SECTION OF AN OBJECT

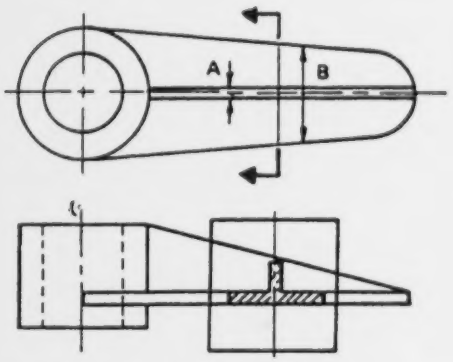
Premise: A revolved section is used to illustrate an area of an object without drawing a separate view. A revolved section of an object can be constructed by using the procedure in the following example.

Example:

1. Pass an imaginary plane through the area

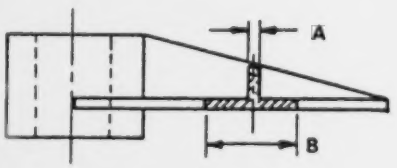


2. Indicate cutting plane line and rotate plane in front view

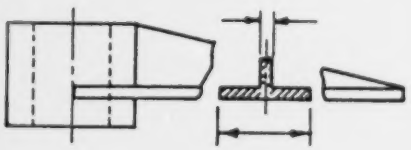


3. The section can be shown in one of two ways (a) drawn in context, or (b) object broken away from section

a.

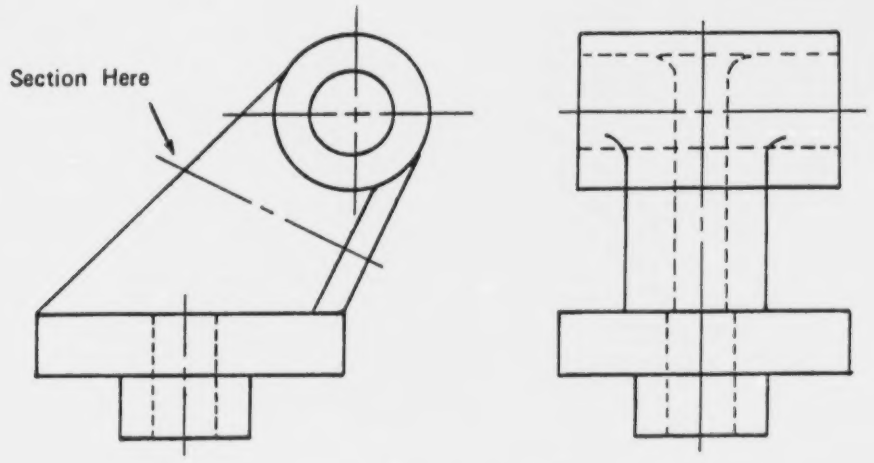


b.



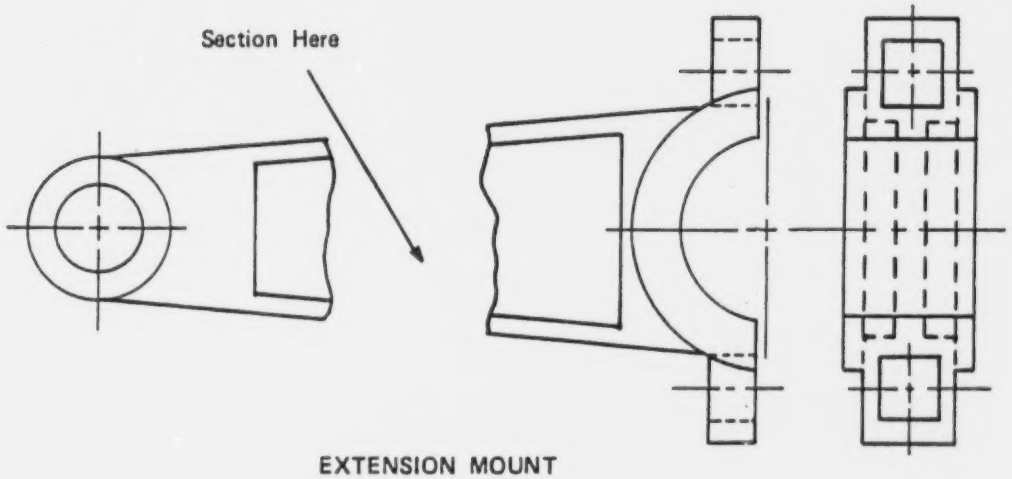
Directions: Construct a revolved section view in the area indicated for the offset bracket and the extension mount.

Problem A:



OFFSET BRACKET

Problem B:



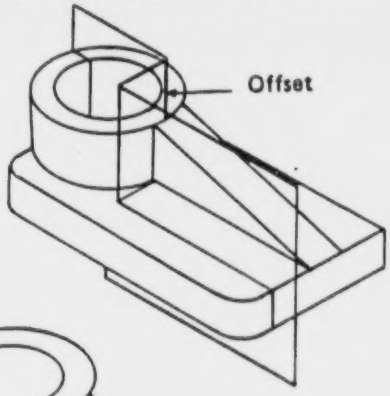
EXTENSION MOUNT

CONSTRUCT A RIB SECTION OF AN OBJECT

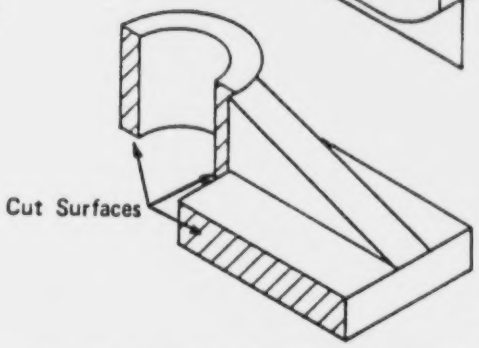
Premise: A rib section of an object can be constructed by using the procedure in the following example.

Example:

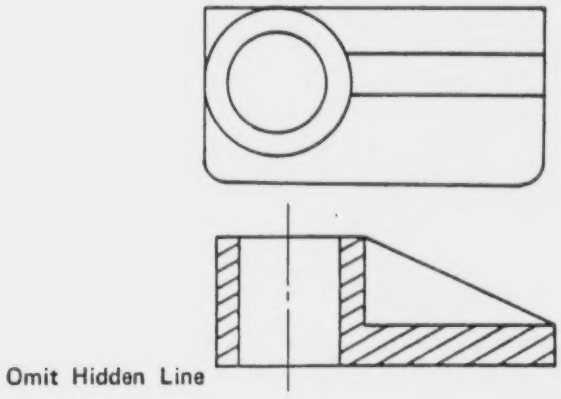
1. When sectioning an area that has a rib or spoke, the cutting plane line offsets in front of the rib



2. Remove front portion and look into the object

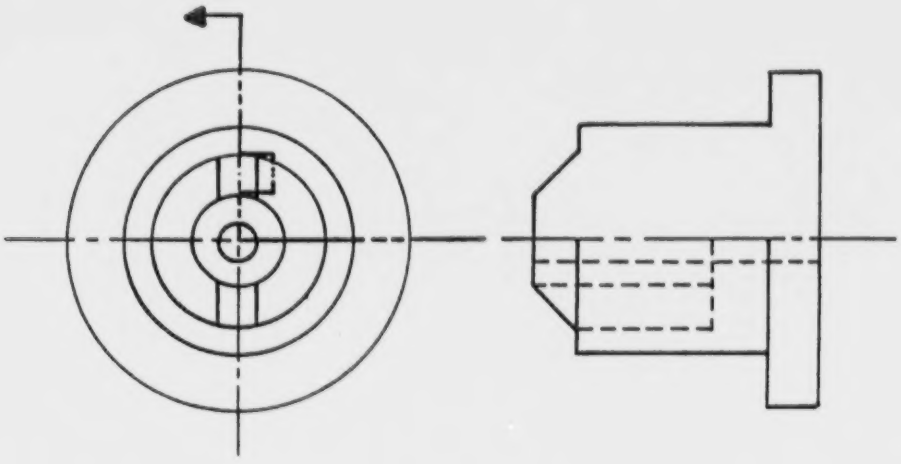


3. Show cutting plane as illustrated in top view; section front view as shown omitting section lines on rib

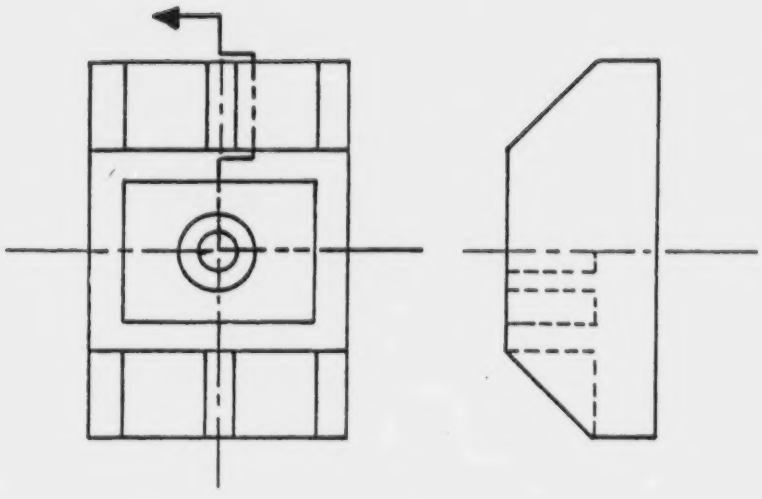


Directions: Construct the right side view with rib sectioned properly for the following problems.

Problem A:



Problem B:

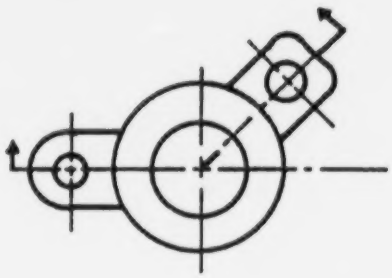


CONSTRUCT AN ALIGNED SECTION OF AN OBJECT WITH HOLES, RIBS, OR SPOKES

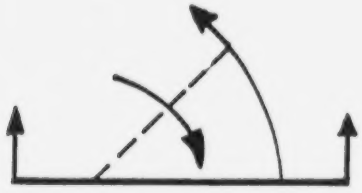
Premise: When the offset is in line with the rest of the object, there is no problem in sectioning. However, when the offsets are not in line, a true projection would be misleading. An aligned section of an object with holes, ribs, or spokes can be constructed by using the procedure in the following example.

Example:

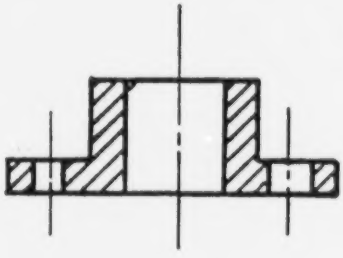
1. Introduce cutting plane line



2. Rotate cutting plane to horizontal axis

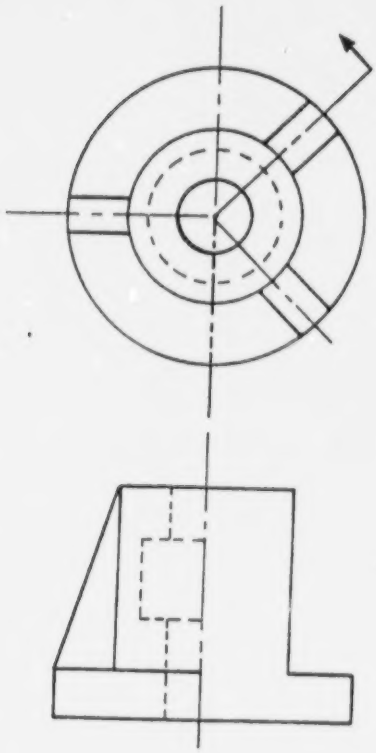


3. Draw in sections as if they were all on horizontal cutting plane

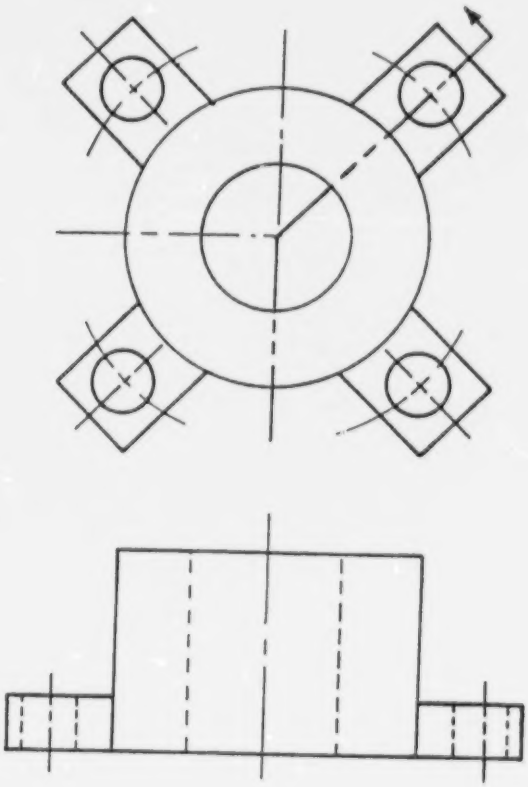


Directions: Construct front views as aligned sections for the following problems.

Problem A:

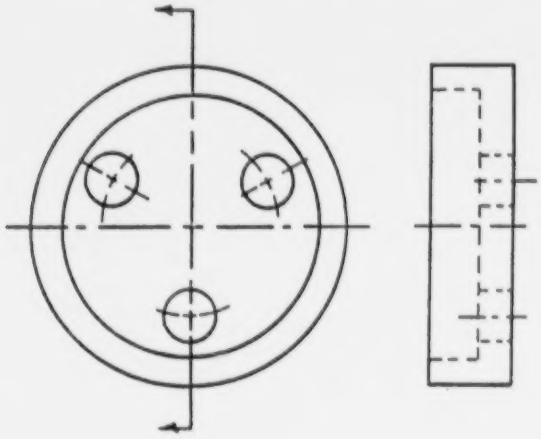


Problem B:

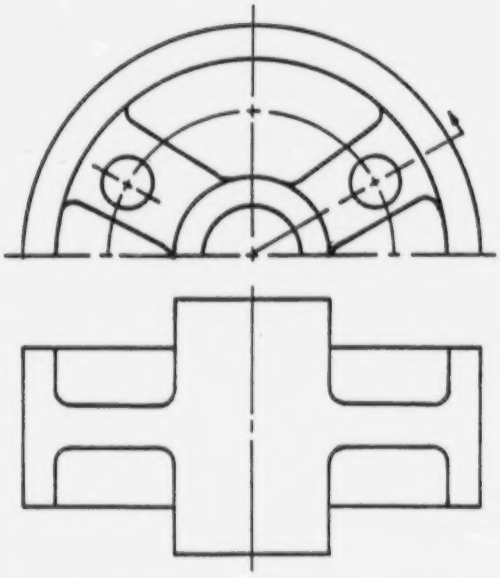


Directions: Construct the right side into aligned section for the following problems.

Problem C:



Problem D:

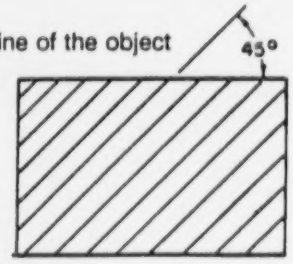


CONSTRUCT ADJACENT PARTS IN ASSEMBLY SECTION

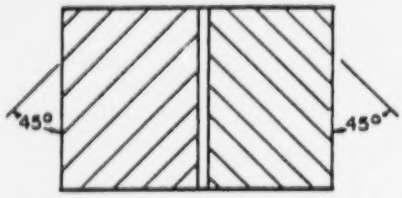
Premise: Adjacent parts in assembly section can be constructed by using the procedure in the following example.

Example:

1. Section lines are constructed at an angle of 45° to the main outline of the object

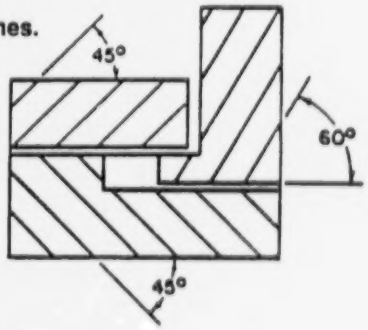


2. On adjacent parts, section lines should be 45° in the opposite direction

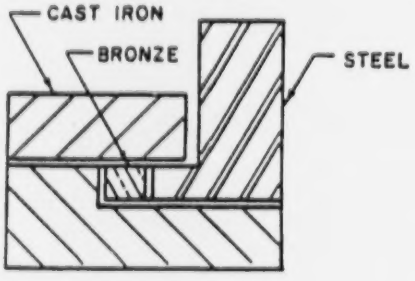


3. For more than two parts adjacent to each other, section lines should be drawn at an angle of 30° or 60°

NOTE: Section lines should not be drawn to meet at common lines.

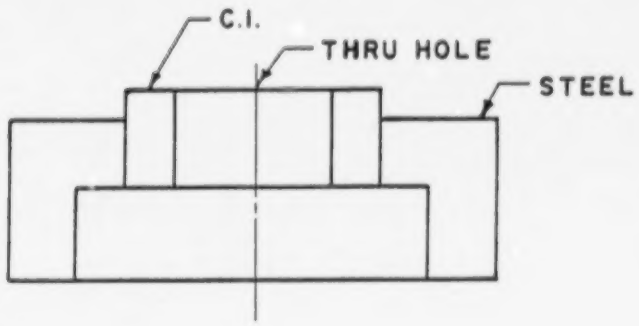


4. Different materials can be used to represent different parts in section



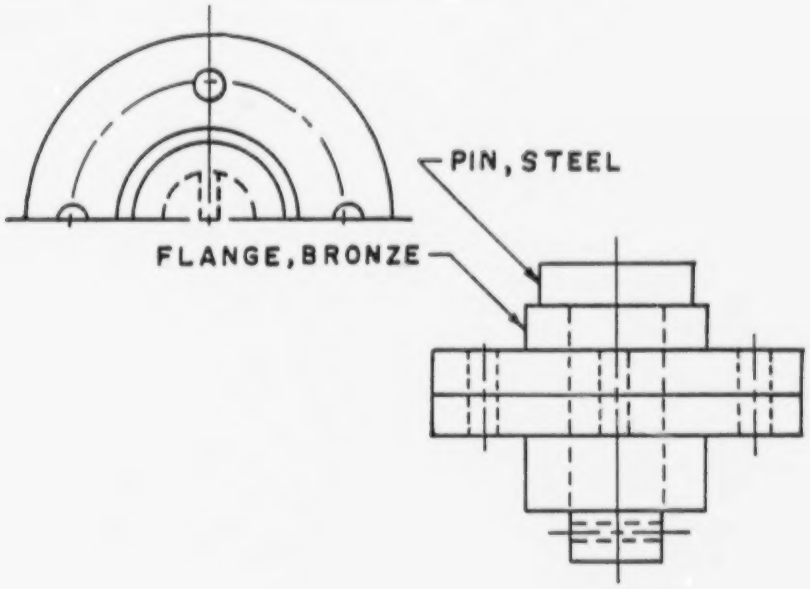
Directions: Complete this assembly as a section using the proper symbols.

Problem A:



Directions: Complete front view as a section using the symbols indicated.

Problem B:



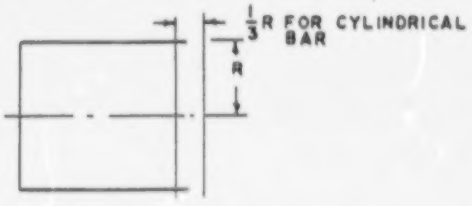
CONSTRUCT CONVENTIONAL BREAKS

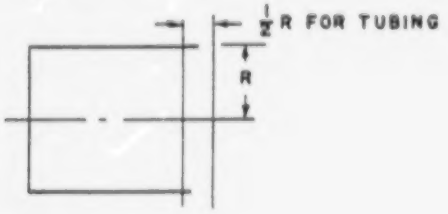
Premise: In constructing a long bar or tubing with uniform cross section, it is usually not necessary to construct its full length. A break is made, sectioned, and the true length of the object is indicated by a dimension. The conventional breaks for cylindrical bars and tubing are known as "S" breaks and may be constructed with templates or free hand. The procedure in the following example is for the use of templates.

Example:

1. Use given rectangular view for bar or tube

2. Lay off fractional radius widths on end to be sectioned



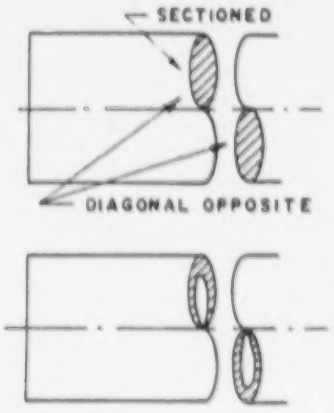


3. Using ellipse template or irregular curve, construct "S" breaks

NOTE: Construct "S" break free hand on small diameter bar or tubing.

4. Add section lining to visible sectioned part

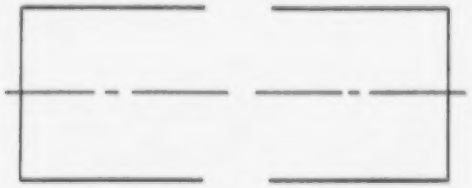
NOTE: When "S" break is shown with stock continuing on both sides of break, the sectioned faces are diagonally opposite.



5. Short or long break symbols are used on rectangular solids

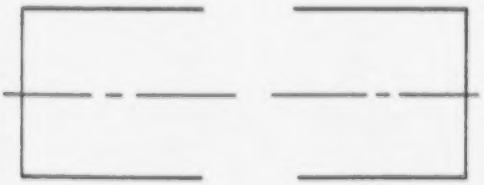
Directions: Construct conventional breaks in the parts below.

Problem A: Cylindrical -- Cast iron



Problem B: Rectangular -- Steel

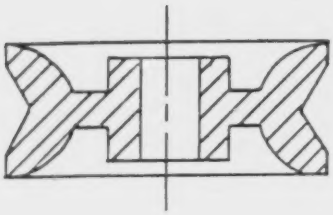
Problem C: Tubular -- Brass



ANSWERS TO ASSIGNMENT SHEETS

AS 1.1

A.



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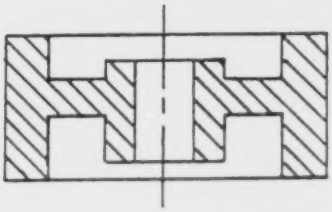

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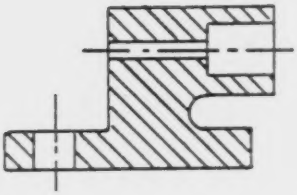

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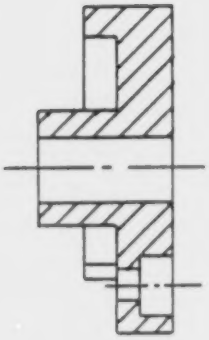

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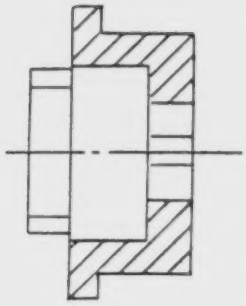
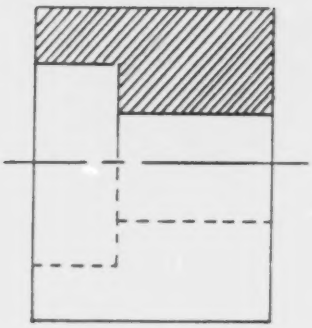
E.



AS 1.2

A.



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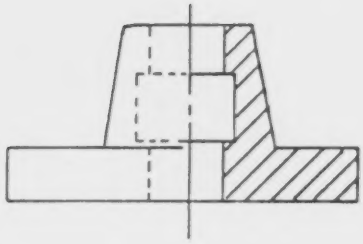

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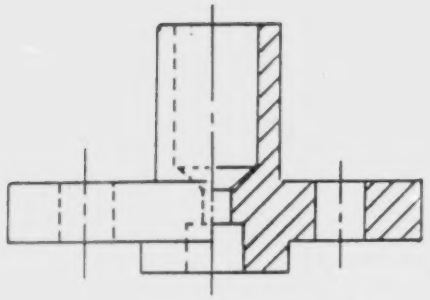
C.



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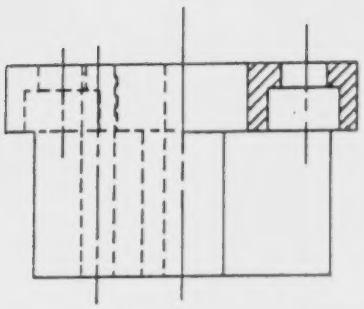

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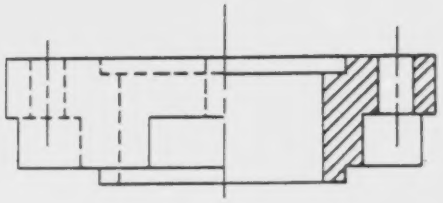

AS 1.3

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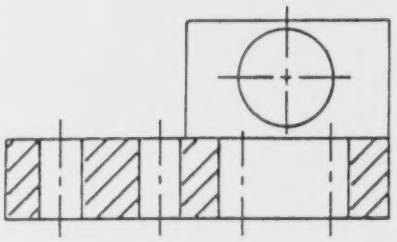

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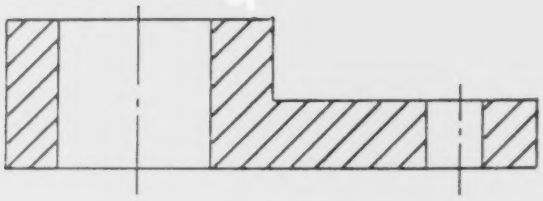

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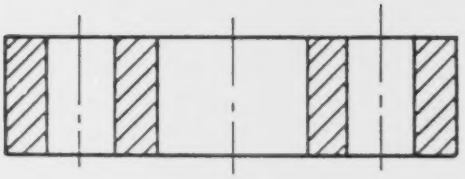

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AS 1.4

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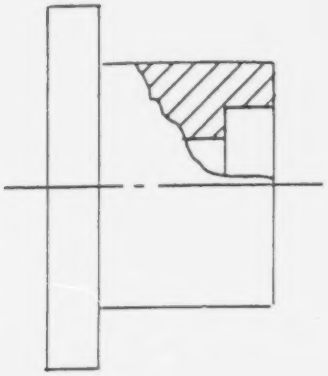

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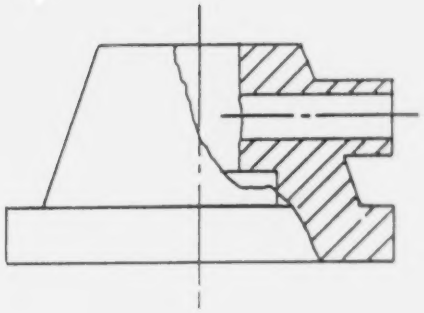

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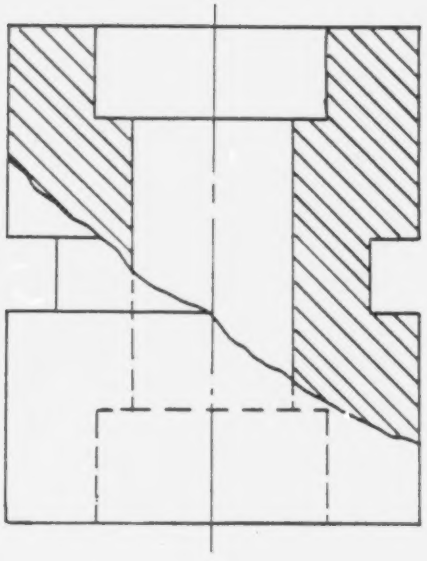

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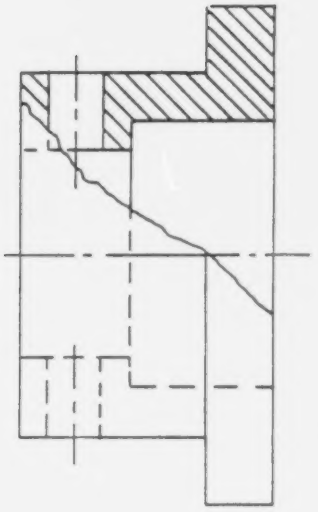

AS 1.5

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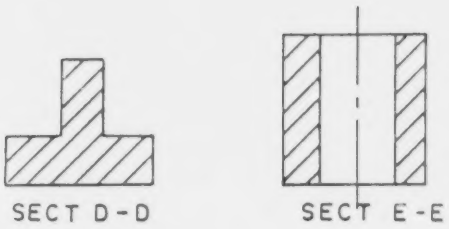

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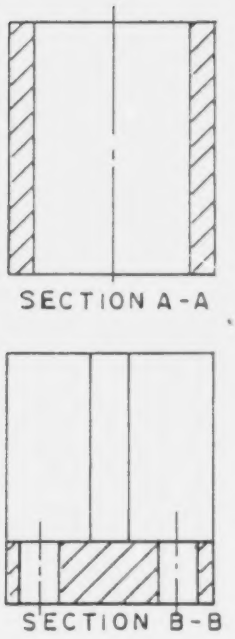
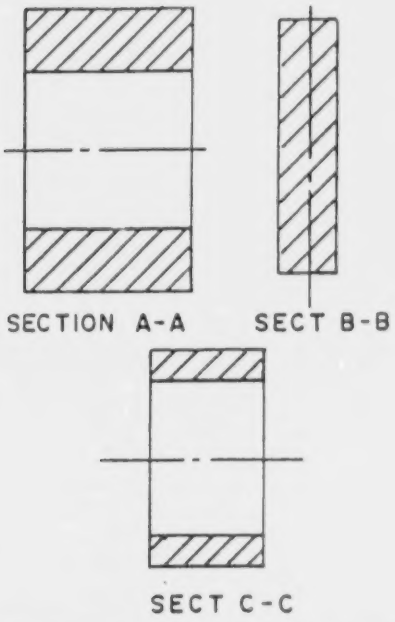


AS 1.5

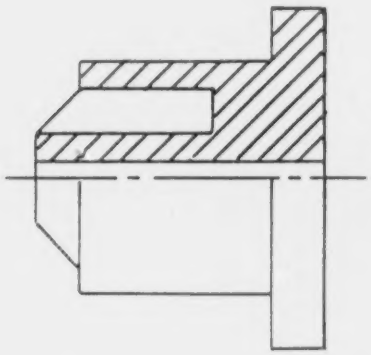
C.



AS 1.6 -- Evaluated to the satisfaction of the instructor

AS 1.7

A.



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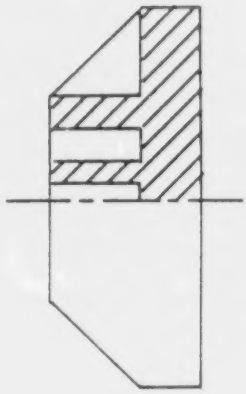

AS 1.8

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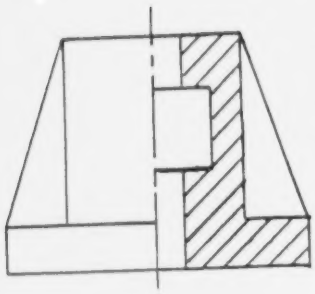

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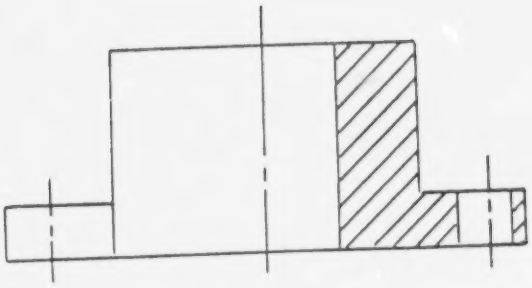

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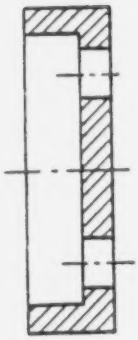
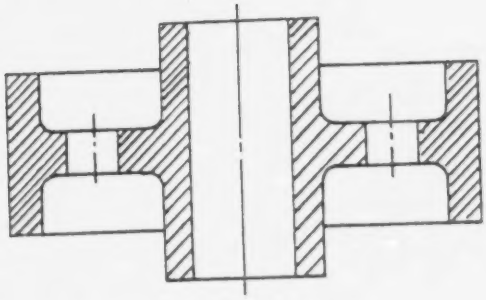


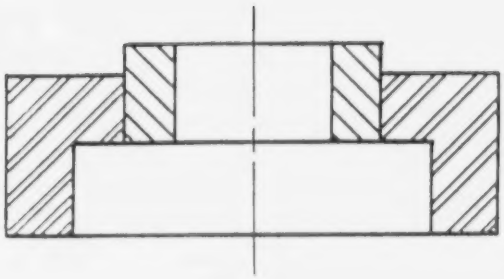
D.



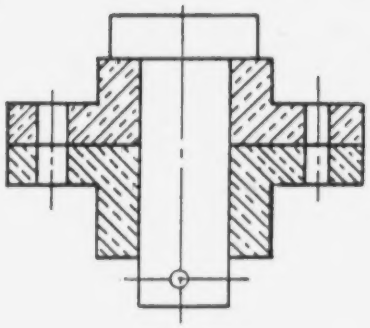
156

AS 1.9

A.



B.



AS 1.10 -- Evaluated to the satisfaction of the instructor

MODULE: RELATED VIEWS AND DESCRIPTIVE GEOMETRY

UNIT II: SECTIONAL VIEWS/CONVENTIONS

UNIT II TEST

Match the terms on the right with their correct definitions on the left.

____	1.	The imaginary cutting away from front viewing portion of the object to show the interior detail	a. Section lining
____	2.	The cutting plane passes completely through an object and the cross section behind the cutting plane line is exposed to view	b. Offset section
____	3.	A line symbol that is drawn on exposed cut surface; sometimes called cross hatching	c. Cutting plane
____	4.	Symbolic section lining used for indicating of various materials	d. Sectional view
____	5.	An imaginary plane used to cut through an object	e. Broken-out section
____	6.	The cutting planes are passed at right angles to each other along the center lines and one-fourth of object is removed	ab. Removed section
____	7.	Has a cutting plane line to pick up features that are not along a common cutting plane	ac. Full section
____	8.	An area broken out of a view that shows only a portion of that view in section	ad. Revolved section
____	9.	A revolved section drawn off the principal view and placed in another convenient location	ae. Half section
____	10.	A cutting plane line is passed through an area and then the image is revolved 90° in position	bc. Section symbols

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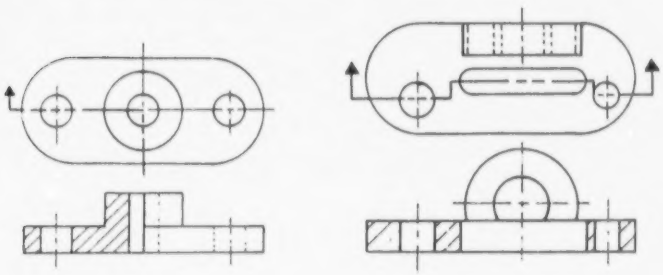
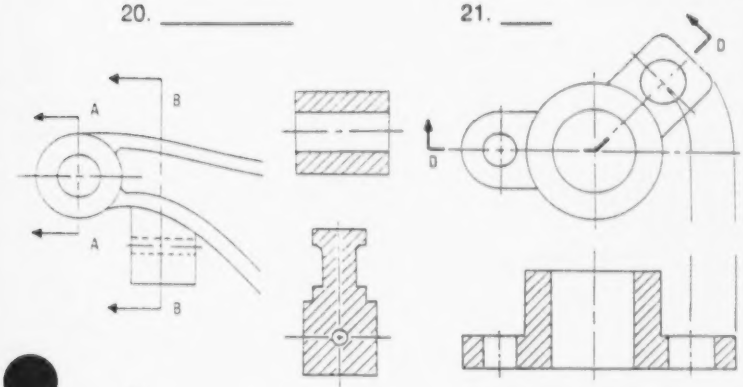
Match the terms on the right with their correct definitions on the left.

____ 11.	Used to align features such as spokes, holes, and ribs along a common plane so that they can be detailed more easily	a.	Thin section
		b.	Aligned section
____ 12.	Materials too thin for section lining are shown solid	c.	Subtitles
		d.	Symmetry
____ 13.	Used for clarity in sections of assembly drawings of standard parts where the axis of the part lies in the cutting plane	e.	Rib section
		ab.	Unlined section
____ 14.	Used in making a shortened view of a long simple object	ac.	Outline sectioning
____ 15.	Shows all parts of an object as one unit and drawn using section lining to make the individual parts stand out	ad.	Assembly section
		ae.	Conventional break
____ 16.	Section lines are shown along the borders of a large part for clarity and to save time		
____ 17.	Method of not showing the ribs section lined eliminates the impression of solidity		
____ 18.	Having the same shape and size on opposite sides of a center line		
____ 19.	Labeling with capital letters the sectional view which has a removed section		

Match types of sectional views with their correct names.



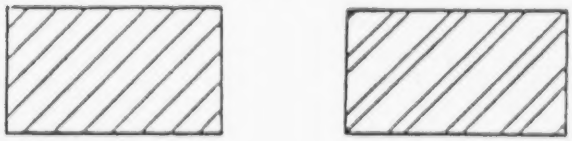
20. _____ 21. _____



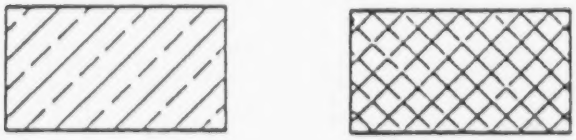
22. _____ 23. _____

a. Removed section
b. Offset section
c. Half section
d. Aligned section

Match material symbols in section with the correct labels.



24. _____ 25. _____



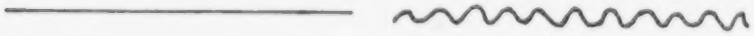
26. _____ 27. _____

a. Zinc, lead, and alloys
b. Steel
c. Cast iron
d. Brass, bronze, or copper

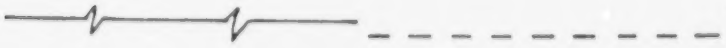
Match types of sections on the right with their correct uses on the left.

___ 28.	To show both interior and exterior features of a symmetrical object.	a.	Revolved section
		b.	Broken-out section
___ 29.	To show the true shape of the cross section of a long object such as a bar, spoke, rib, or arm	c.	Half section
		d.	Aligned section
___ 30.	To show features that are not in a straight line	e.	Offset section
___ 31.	To show interior detail of objects where less than half section is required	ab.	Removed section
		ac.	Full section
___ 32.	Used for clearness and for easier dimensioning		
___ 33.	Replaces an exterior view in order to show some interior details		
___ 34.	Used when true projection would be confusing for spokes, ribs, and holes		

Identify line type and thickness used in sectional drawings by matching the lines with their correct names.



35. _____ 36. _____

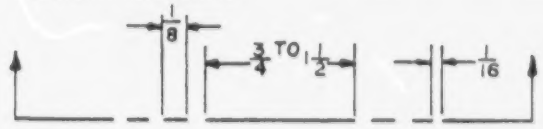


37. _____ 38. _____

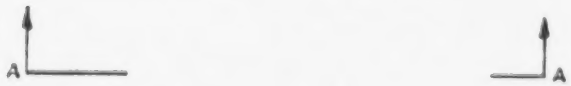
		a.	Hidden line, thin
		b.	Section line, thin
		c.	Long break line, thin
		d.	Short break line, thick

___ 39. **Select the most commonly used form of cutting plane lines by placing the correct letter in the blank.**

a.



b.



c.

Select true statements concerning general rules in sectioning by placing an "a" in the appropriate blanks. Mark a "b" for false statements.

___ 40. Hidden lines behind the cutting plane should be omitted unless needed

___ 41. Sections which are too thin for effective section lining are shown as broken lines

___ 42. Large surfaces are often sectioned only along the edge of the part

___ 43. If two or more sections appear on the same drawing, labeling is not necessary

___ 44. Section lines are thick wavy lines drawn vertical to main outline of the view

___ 45. Section lines are uniformly spaced 1" apart

___ 46. Where two or more thin sections are shown, a space should be left between them

___ 47. When the cutting plane offsets, a line is always shown in the sectioned view to present the offset

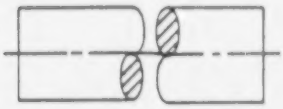
___ 48. When object have one major center line, the cutting plane line may be omitted

___ 49. A center line or a visible line may not be used to divide the sectioned half from the unsectioned half

___ 50. Hidden lines cannot be added to unsectioned half for dimensioning

___ 51. Visible lines behind cutting plane line should not be omitted

Match types of conventional breaks with their correct names.



52. _____

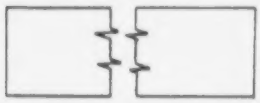
53. _____

a. Long break

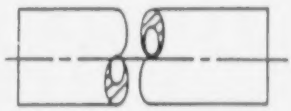
b. Rectangular solid

c. Round bar

d. Round tubular



54. _____



55. _____

Select true statements concerning use of unlined sections by placing an "a" in the appropriate blanks. Mark a "b" for false statements.

____ 56. Thin parts are made solid

____ 57. Shafts, bolts, nuts, pins, keys, rivets, gear teeth, and similar parts should always be sectioned if axis lies in cutting plane

____ 58. Broken-out section of shaft may be made to indicate clearness of key, key seat, and pin

Select true statements concerning labeling sectional views by placing an "a" in the appropriate blanks. Mark a "b" for false statements.

____ 59. More than one removed section view should be labeled with letters corresponding to the ends of the cutting plane line

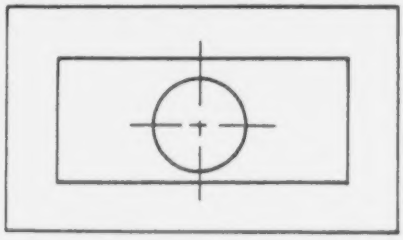
____ 60. Sectional views should be arranged in alphabetical order from right to left on the drawing

____ 61. Section letters should be used in alphabetical order

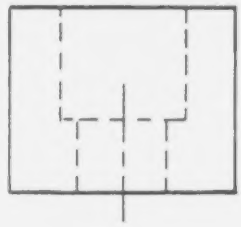
____ 62. Letters "B", "C", and "X" should not be used

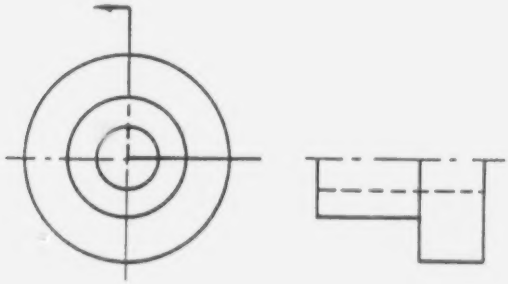
Construct various sectional views.

63. Complete front view as a full section.



64. Complete right side as a half section.

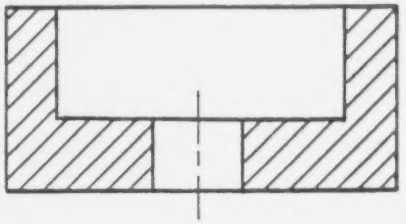




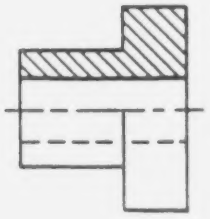
ANSWERS TO UNIT II TEST

1. d (G, 1-5)
2. ac (G, 1-5)
3. a (G, 1-5)
4. bc (G, 1-5)
5. c (G, 1-5)
6. ae (G, 1-5)
7. b (G, 1-5)
8. e (G, 1-5)
9. ab (G, 1-5)
10. ad (G, 1-5)
11. b (G, 1-5)
12. a (G, 1-5)
13. ab (G, 1-5)
14. ae (G, 1-5)
15. ad (G, 1-5)
16. ac (G, 1-5)
17. e (G, 1-5)
18. d (G, 1-5)
19. c (G, 1-5)
20. c (G-1)
21. b (G-1)
22. a (G-1)
23. d (G-1)
24. c (G-2)
25. b (G-2)
26. d (G-2)
27. a (G-2)
28. c (G-5)
29. a (G-5)
30. e (G-5)
31. b (G-5)
32. ab (G-5)
33. ac (G-5)
34. d (G-5)
35. b (G, 1-5)
36. d (G, 1-5)
37. c (G, 1-5)
38. a (G, 1-5)
39. a (G-3)
40. a (G-1)
41. b (G-1)
42. a (G-1)
43. b (G-1)
44. b (G-1)
45. b (G-1)
46. a (G-1)
47. b (G-1)
48. a (G-1)
49. b (G-1)
50. b (G-1)
51. a (G-1)
52. c (G-4)
53. b (G-4)
54. a (G-4)
55. d (G-4)
56. a (G-1)
57. b (G-1)
58. a (G-1)
59. a (G,1 and 3)
60. b (G,1 and 3)
61. a (G,1 and 3)
62. b (G,1 and 3)

63. (G-1)



64. (G-1)



MODULE: RELATED VIEWS AND DESCRIPTIVE GEOMETRY

UNIT III: DESCRIPTIVE GEOMETRY

UNIT OBJECTIVE

After completion of this unit, the student should be able to determine true angle between planes, and determine shortest distance between lines, identify true lengths and true sizes of surfaces, construct true lengths and true sizes by rotation, and construct intersections of surfaces and sheet metal developments. This knowledge will be evidenced by correctly performing the procedures outlined in the assignment sheets and by scoring ___ percent on the unit test.

(NOTE: Review "Orthographic Views," "Geometric Construction," and "Auxiliary Views" before attempting this unit.)

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1.1 Match terms related the auxiliary views with their correct definitions.

1.2 List the different locations of a reference line.

1.3 List methods for finding intersections of surfaces.

1.4 Demonstrate the ability to:

- a. Construct true length of an oblique line.
- b. Determine the true angle between two planes.
- c. Determine visibility of crossing skew lines in space.
- d. Determine the visibility of a line and a plane that cross in space.
- e. Locate piercing point of a line and a plane.
- f. Construct point view of a line.
- g. Determine true angle between two planes in a secondary auxiliary.
- h. Construct a true size auxiliary of an oblique plane.
- i. Determine shortest distance between a point and a line.
- j. Determine shortest distance between two skew lines.
- k. Construct intersections of surfaces.

MODULE: RELATED VIEWS AND DESCRIPTIVE GEOMETRY

UNIT III: DESCRIPTIVE GEOMETRY

CONTENTS OF THIS UNIT

A. Objective sheets

B. Notes to the instructor

C. References

D. Lesson 1: DESCRIPTIVE GEOMETRY

a. Information outline

b. Transparency masters

TM 1.1: Possible Reference Plane Locations
TM 1.2: Intersections with Edge View Given
TM 1.3: Intersections Using Auxiliary Views
TM 1.4: Intersections of Cylinders

c. Assignment sheets

AS 1.1: Construct True Length of an Oblique Line
AS 1.2: Determine the True Angle Between Two Planes
AS 1.3: Determine Visibility of Crossing Skew Lines in Space
AS 1.4: Determine the Visibility of a Line and a Plane that Cross in Space
AS 1.5: Locate Piercing Point of a Line and a Plane
AS 1.6: Construct Point View of a Line
AS 1.7: Determine True Angle Between Two Planes in a Secondary Auxiliary
AS 1.8: Construct a True Size Auxiliary of an Oblique Plane
AS 1.9: Determine Shortest Distance Between a Point and a Line
AS 1.10: Determine Shortest Distance Between Two Skew Lines
AS 1.11: Construct Intersections of Surfaces

E. Answers to assignment sheets

F. Unit test

G. Answers to unit test

REFERENCES

1. Brown, Walter C. Drafting for Industry. Revised ed. South Holland, Ill. 60473: Goodheart-Willcox Co., Inc., 1990.

2. Davis, Ronald, Bill Hill and Bruce Yancey. Basic Drafting: Book Two. Stillwater, Okla. 74074: Mid-America Vocational Curriculum Consortium, Inc., 1981.

3. Dygdon, John Thomas, Frederick E. Giesecke, Ivan Leroy Hill, Alva Mitchell, and Henry Cecil Spencer. Technical Drawing, 8th edition. New York: Macmillan Publishing Company, 1986.

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7. Spence, William P. Drafting Technology and Practice. Revised ed. Pittsburgh, Kan. 66762: Bennett & McKnight Publishing Company, 1980.

8. Wallach, Paul Ross and Dean Chawenhill. Drafting in a Computer Age. Albany, N.Y. Delmar Publishers, Inc., 1989.

NOTES TO THE INSTRUCTOR

A. Suggested approaches to teaching this unit:

1. Construct a "Glass Box Model" to demonstrate auxiliary projection.

2. Bring in other blocks or objects.

3. Explain the use and need for auxiliary views.

MODULE: RELATED VIEWS AND DESCRIPTIVE GEOMETRY

UNIT III: DESCRIPTIVE GEOMETRY

LESSON 1: DESCRIPTIVE GEOMETRY

I. Terms and definitions

A. **Auxiliary view**--a view or surface that is not perpendicular or right angle to the plane of projection

B. **Edge view**--a line representing the inclined plane

C. **Fold line**--a theoretical line between two views where viewing planes fold

D. **Foreshortened**--to appear shorter to the eye than it actually is

E. **Inclined plane**--a plane that is foreshortened in two principal viewing planes and edge view in one other principal viewing plane

F. **Line of sight**--direction from which an object is being viewed

G. **Oblique plane**--a plane that is foreshortened in all three principal viewing planes

H. **Perpendicular line**--a line at 90° to a given plane of projection

I. **Primary auxiliary view**--a first projection of an inclined plane from one of the principal views

J. **Reference line**--a common line on back side, center, front side, or between views from which depth measurements are taken

K. **Secondary auxiliary view**--oblique plane or line projected from a primary auxiliary view and one of the principal views

L. **Skew lines**--nonintersecting lines, not parallel to each other or to the principal views

M. **Symmetrical**--has same shape and size on opposite sides of a center line

N. **Transfer**--take from one point or view and put in another view

O. **True size**--a surface that is shown in its actual size

NOTE: This is based upon the scale used.

P. **True length line**--a line that appears in its actual length

Q. **True angle**--an angle formed by two intersecting planes

NOTE: This is often referred to as a dihedral angle.

II. Different locations of a reference line (TM 1.1)

A. Back edge of view

B. Center line

C. Front edge of view

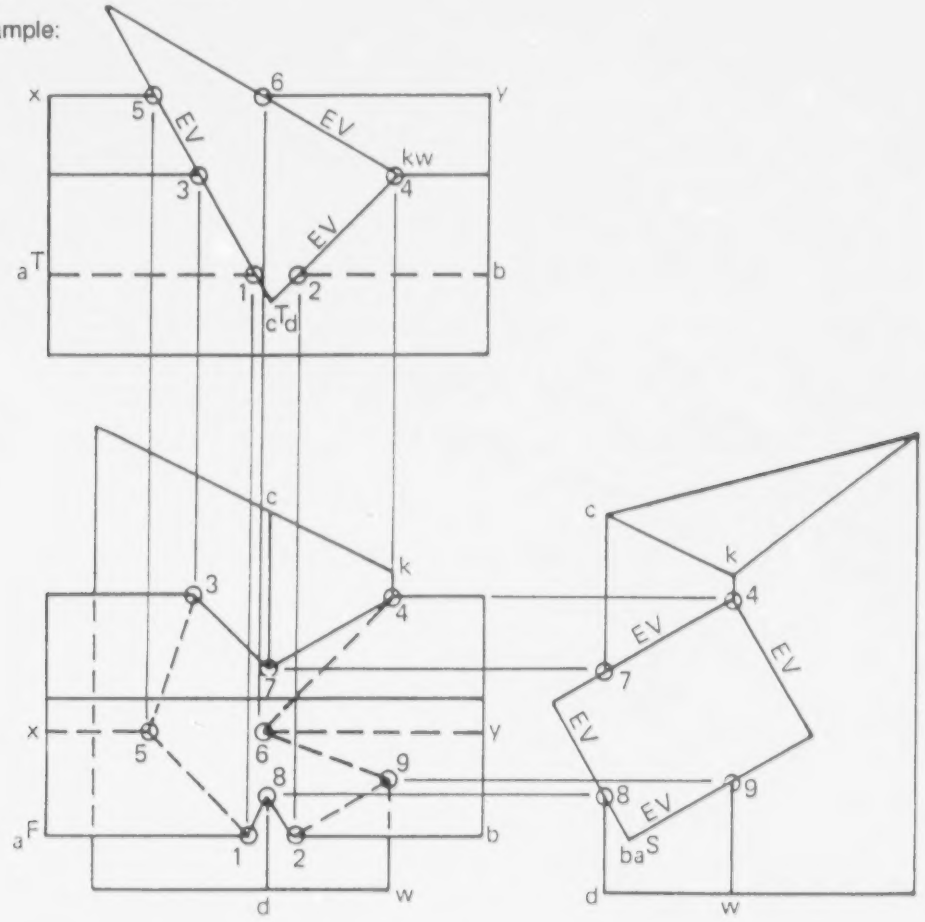
D. Between views

NOTE: These are referred to as fold lines.

III. Methods for finding intersections of surfaces

A. Edge view given (TM 1.2)

Example:



1. When edge views are given, existing piercing points can be readily located and projected

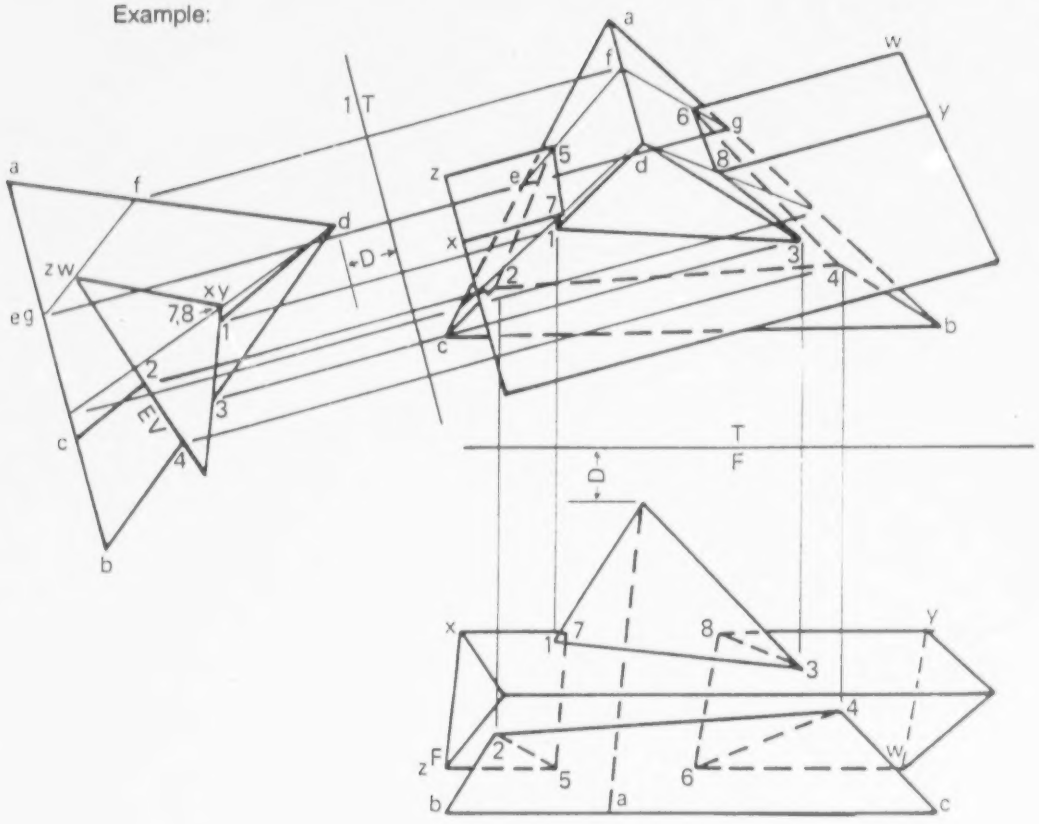
2. Visibility requires logical thinking of the position of the line of sight and what is near the observer and what is far from the observer

3. Points 5 and 6 can be observed in top view where line xy intersects the two edge views

4. Points 8 and 9 can be observed in the side of view where the edges of the planes are intersected by cd and kw

B. Auxiliary view method (TM 1.3)

Example:



1. Construct an auxiliary view to give edges of surfaces

   a. Line zw is in TL in top view

   b. LOS is parallel to TL to give edge views of the planes in the auxiliary view

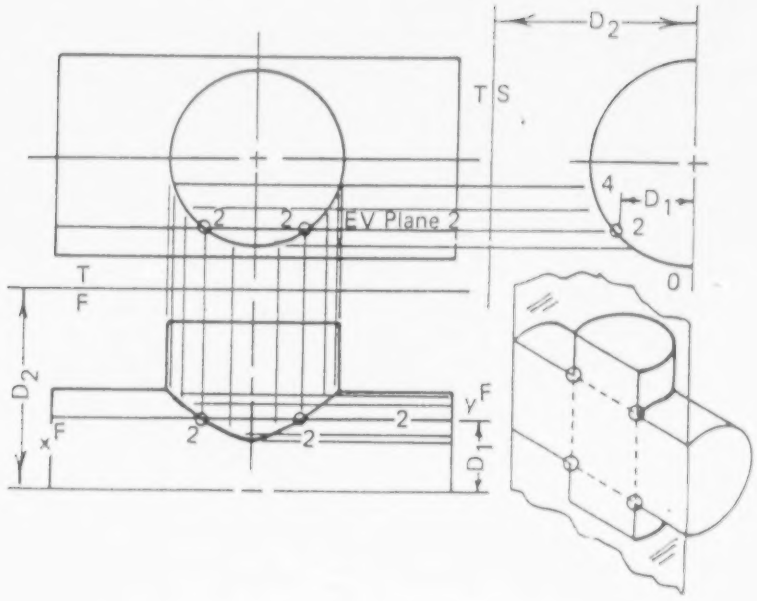
2. When edges are constructed, piercing points may be readily located and projected

   NOTE: The two view method can be used to find additional piercing points.

3. The two view method of piercing points is used to find where line zw and xy intersect the planes adc and adb

4. Visibility requires logical thinking of the position of the line of sight and what is near the observer and what is far from the observer

C. Cylinders intersecting (TM 1.4)

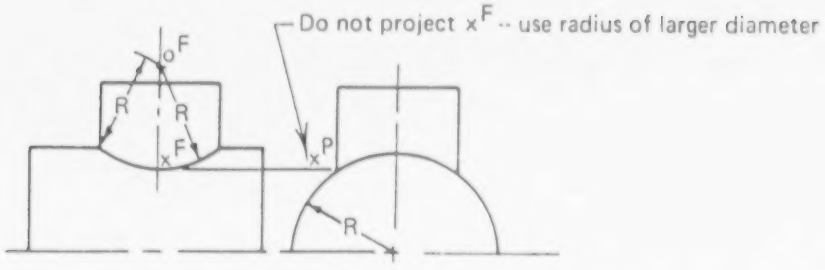


1. Locate elements on surface of cylinders
2. Find their intersection
3. Use correct visibility

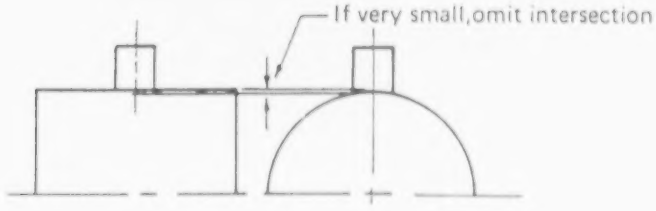
171

D. Approximate intersections

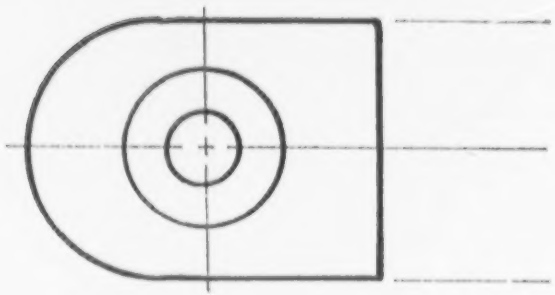
1. Large diameters--use radius of larger cylinder



2. Small diameters--ignore intersection



Possible Reference Plane Locations



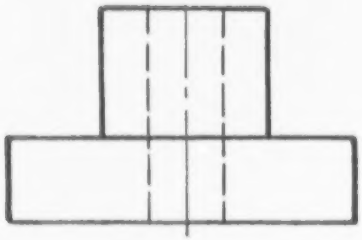
Back Side

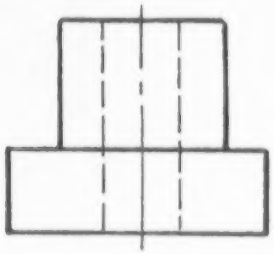
Middle

Front Side

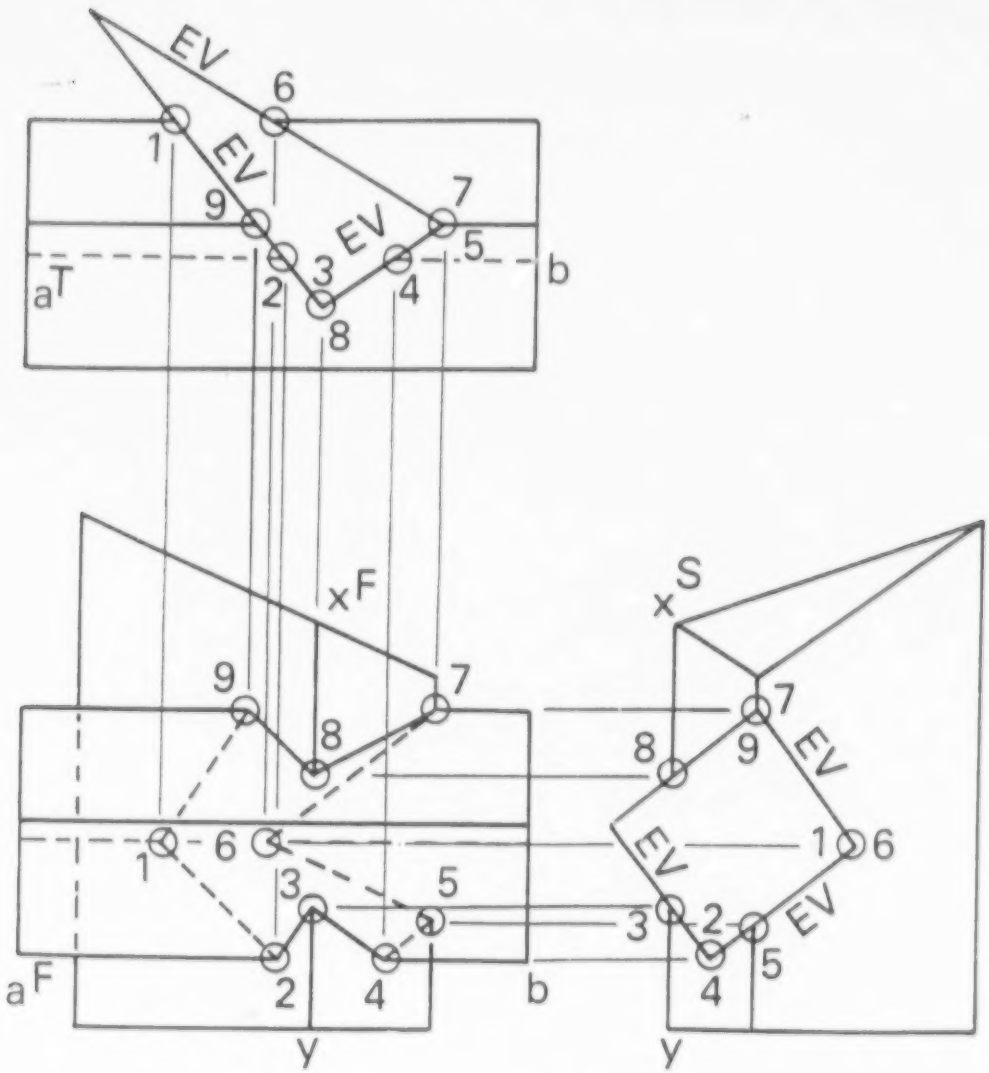
Fold Line

Between Object

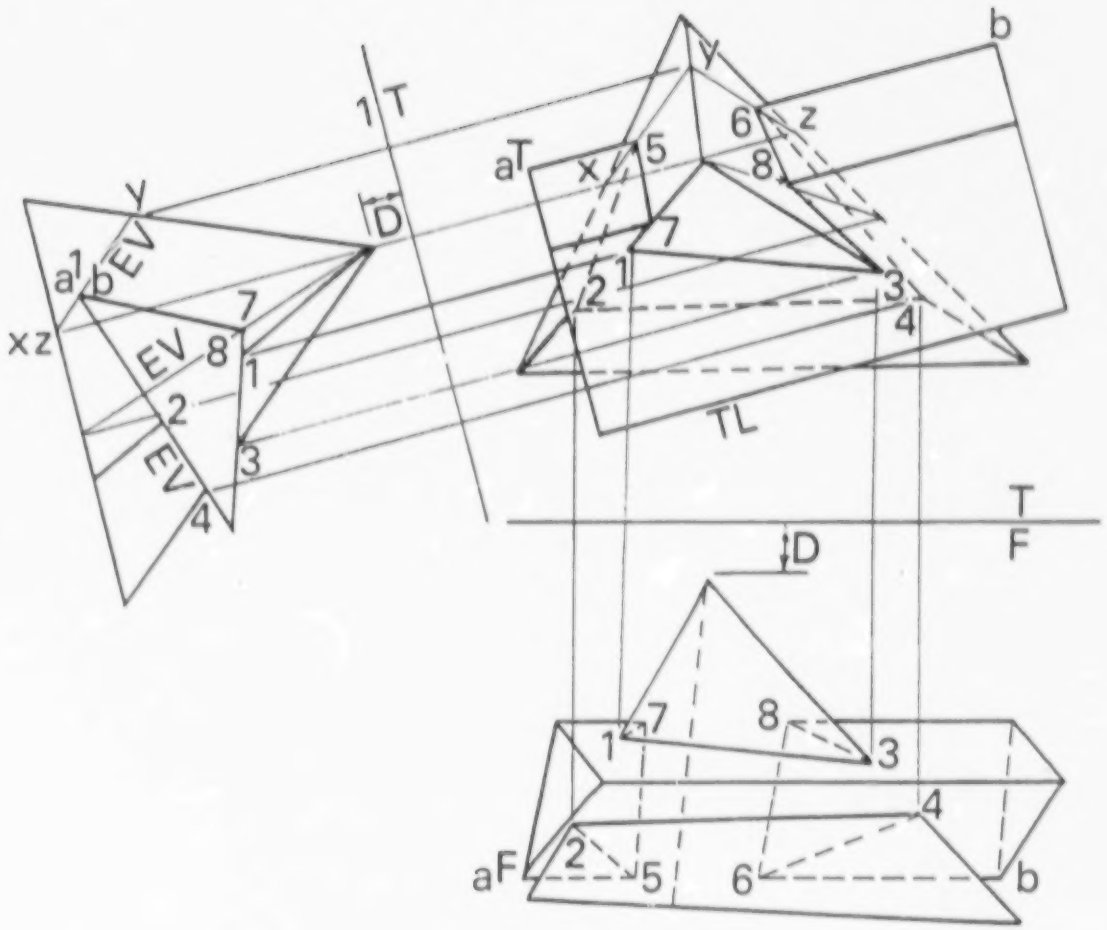




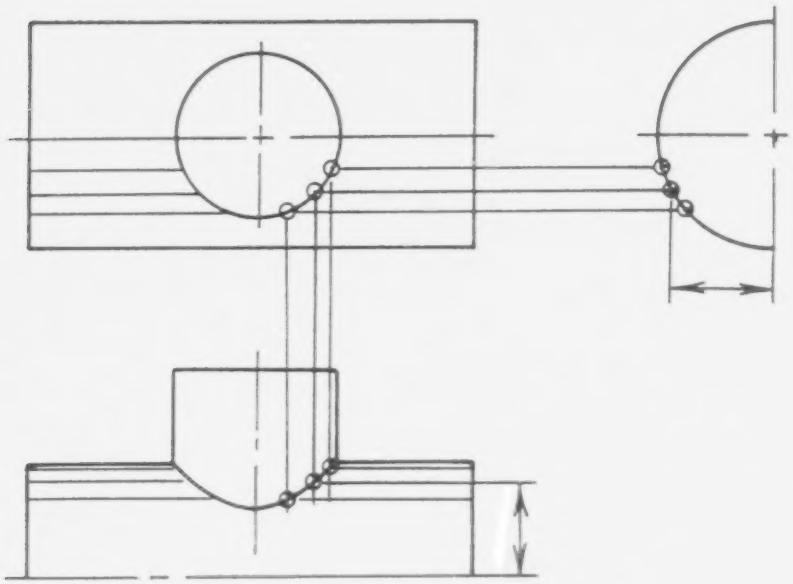
Intersections With Edge View Given



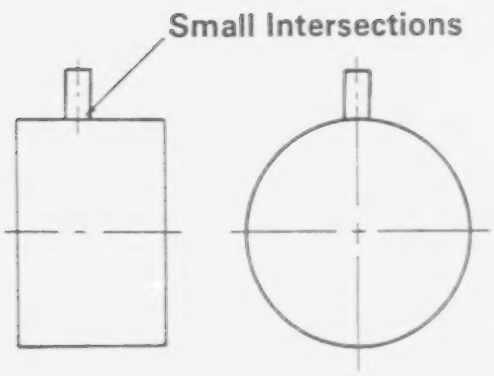
Intersections Using Auxiliary Views



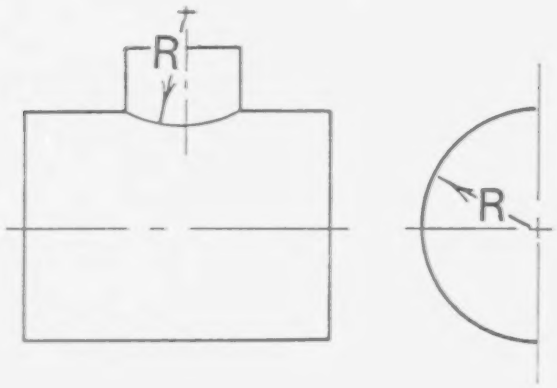
Intersections of Cylinders



Projection



Ignore



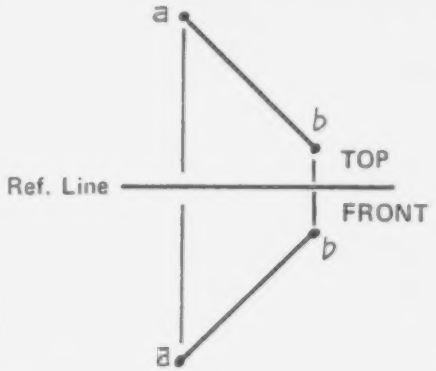
Approximate

CONSTRUCT TRUE LENGTH OF AN OBLIQUE LINE

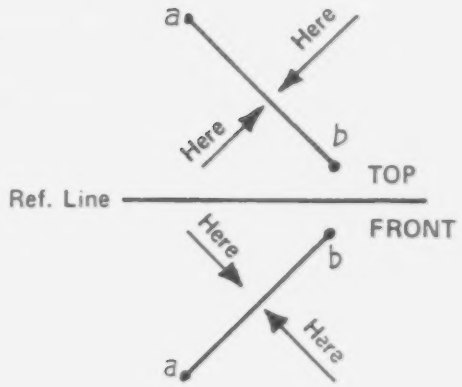
Premise: When a line is oblique to any principal views, an auxiliary view is required to find the true length. True length of an oblique line can be constructed by using the procedure in the following example.

Example:

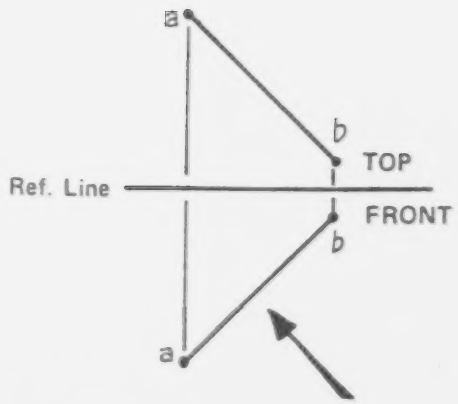
1. Use given two views of a skewed line a-b



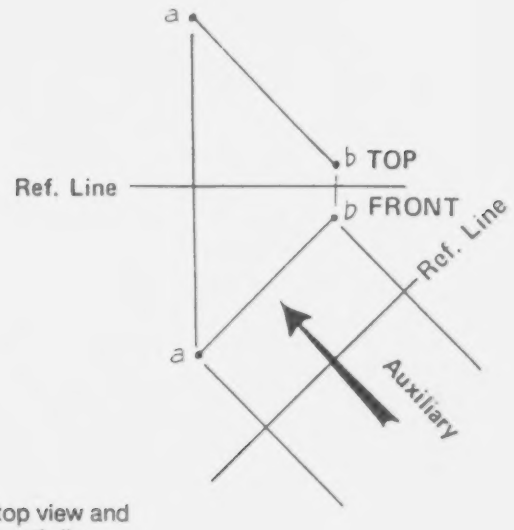
2. Assume 90° line of sight from any one of the four directions shown



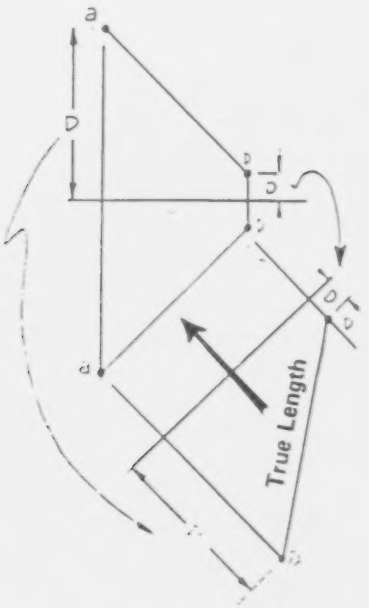
3. Select a line of sight with least amount of congestion and most drawing space



4. Assume reference line at a convenient distance perpendicular to line of sight; project points a-b through reference plane

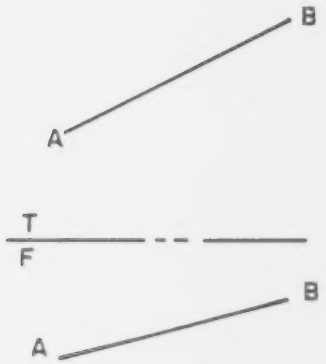


5. Transfer points a and b from top view and connect points to form true length line

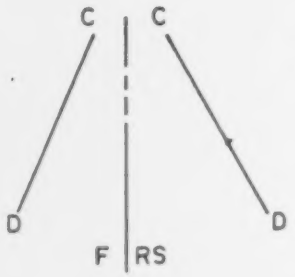


Directions: Construct true length of the lines given below. Label line TL.

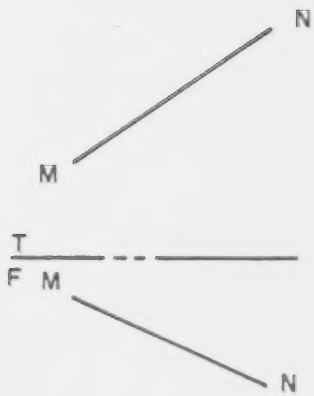
Problem A:



Problem B:



Problem C:



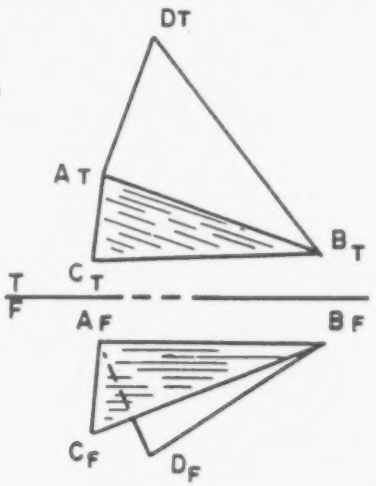
Problem D:

DETERMINE THE TRUE ANGLE BETWEEN TWO PLANES

Premise: In the design and manufacture of the parts, it is sometimes necessary to determine the angle between two planes. This angle can be determined when the line of intersection is parallel to one of the principal views. The true angle between two planes can be determined by using the procedure in the following example.

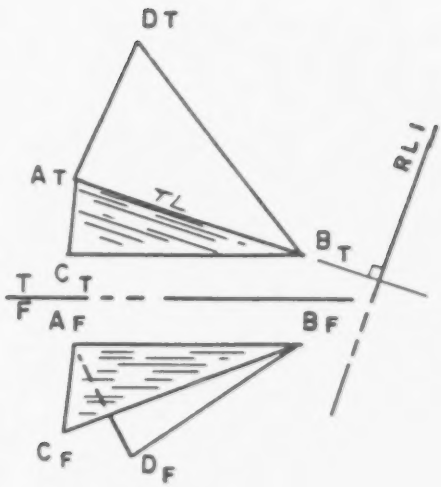
Example:

1. Use given top and front views of the two planes



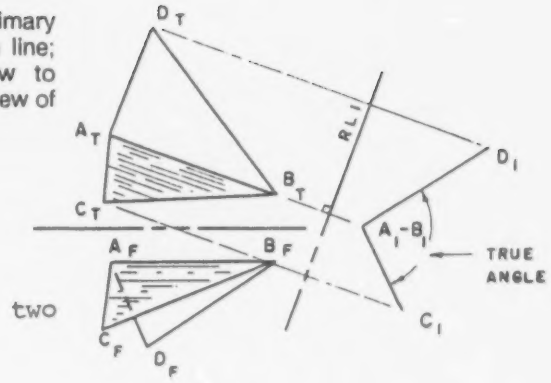
2. Line of intersection at A_T B_T is viewed in its true length in top view

NOTE: For this procedure that line of intersection must be parallel to one of the principal planes.



3. Construct reference line RL1 perpendicular to true length line

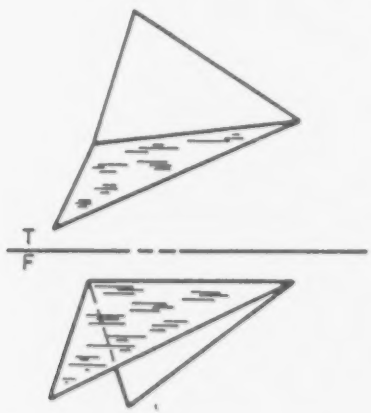
4. Project points from top view to primary auxiliary perpendicular to reference line; transfer distances from front view to primary auxiliary to establish edge view of planes



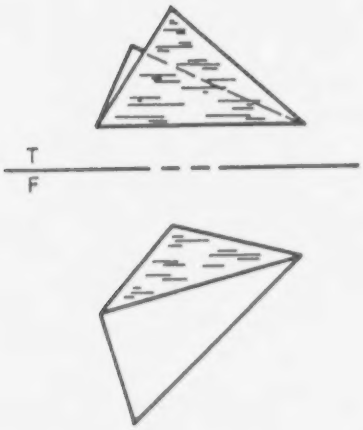
5. Measure true angle between the two planes

Directions: Determine the true angle between two planes in the following problems. Measure angle with protractor. Label corners of planes. Leave construction lines.

Problem A:



Problem B:

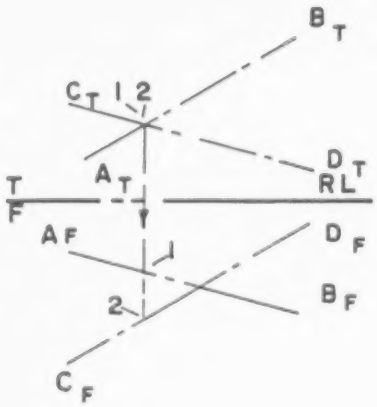


DETERMINE VISIBILITY OF CROSSING SKEW LINES IN SPACE

Premise: In the example of two nonintersecting pipes shown below, the visibility of the pipe nearest to the viewer cannot be determined. The procedure in the following example can be used to determine which pipe lies in front of the other.

Example:

1. Use given two views of crossing pipes with center lines labeled

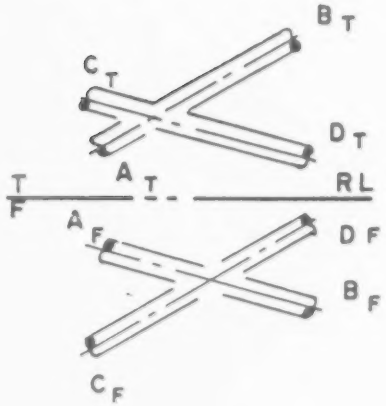


2. Determine visibility of line in top view

   a. Label the crossing of lines A_T, B_T, and C_T, D_T, as 1,2

   b. Project the crossing point to the front view, establishing points 1, 2

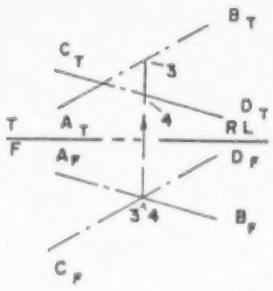
   c. Point 1 is closer to reference line; therefore line A_T, B_T is nearer in top view and is visible



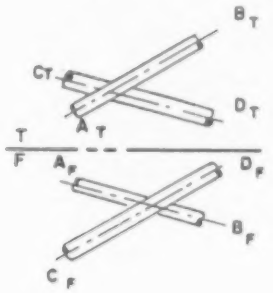
3. Determine the visible line in front view

a. Label the crossing of lines A_F, B_F, and C_F, D_F as 3, 4

b. Project the crossing point to the top view, establishing points 3, 4

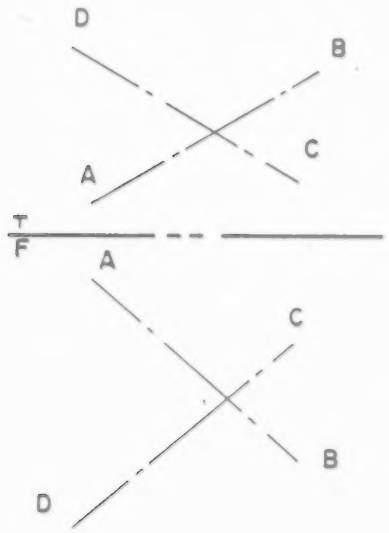


c. Point 4 is closer to reference line; therefore, line A_F, B_F is nearer in front view and is visible

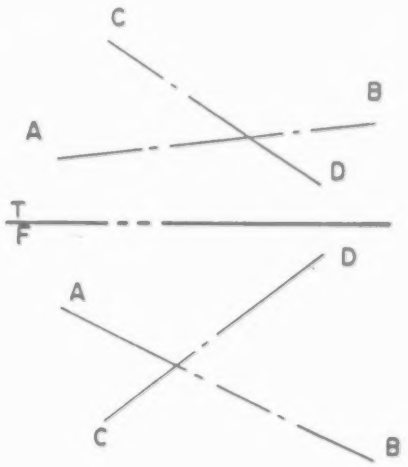


Directions: Determine which pipe is closer to the viewer in the following views. Complete the shape of pipes and leave projection lines.

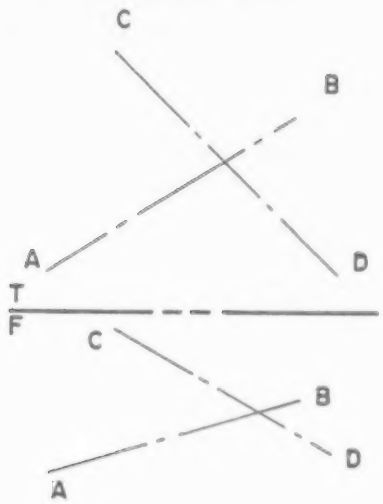
Problem A:



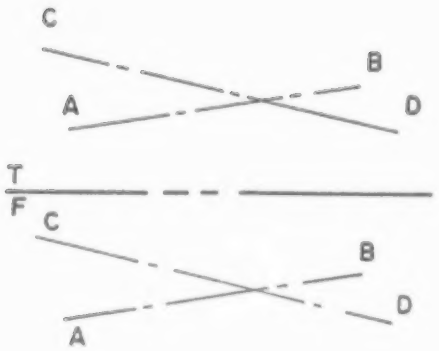
Problem B:



Problem C:



Problem D:

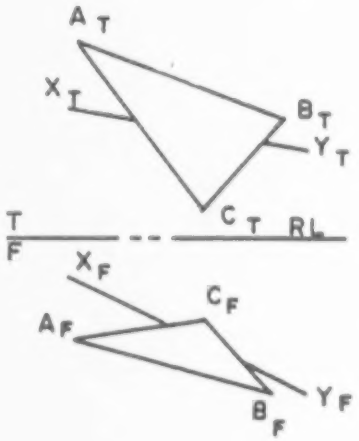


DETERMINE THE VISIBILITY OF A LINE AND A PLANE THAT CROSS IN SPACE

Premise: Determining the visibility of a line and a plane that cross in space is similar to that of crossing lines. The visibility of a line and a plane that cross in space can be determined by using the procedure in the following example.

Examples:

1. Use given two views of plane ABC and XY crossing in space

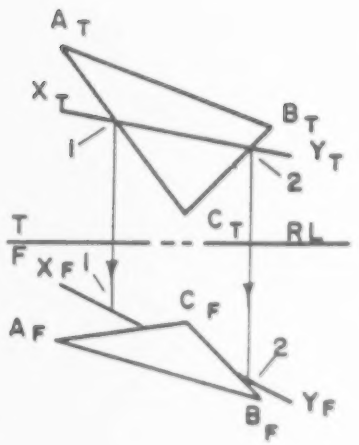


2. Determine visibility of line in top view

   a. Label the crossing of line X_T, Y_T with plane A_T, B_T, C_T, as 1, 2

   b. Project the crossing points to the front view, establishing points, 1, 2

   c. The projected lines intersect line X_F, Y_F before they intersect the plane; therefore, line X_F, Y_F is nearer to top view and is visible



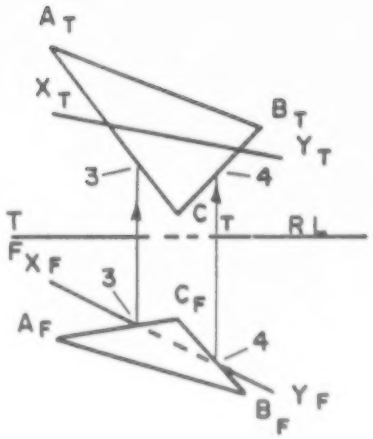
3. Determine visibility of line in front view

a. Label the crossing of line X_F Y_F with plane A_F B_F C_F as 3, 4

b. Project the crossing points to the top view, establishing points, 3, 4

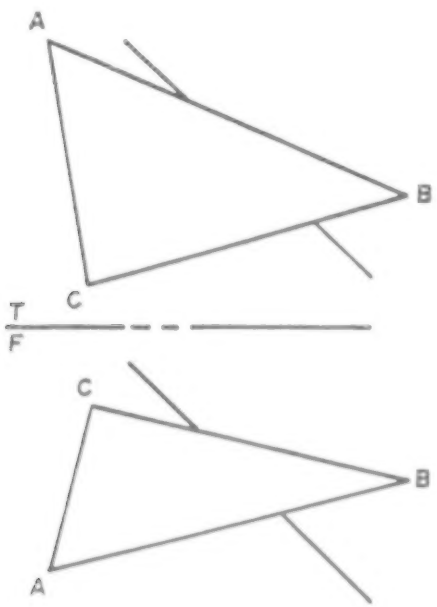
c. The projected lines intersect the plane before they intersect the line; therefore, line X_F Y_F is hidden in the front view

NOTE: The plane is nearer to the front view and line XY crosses behind plane ABC.

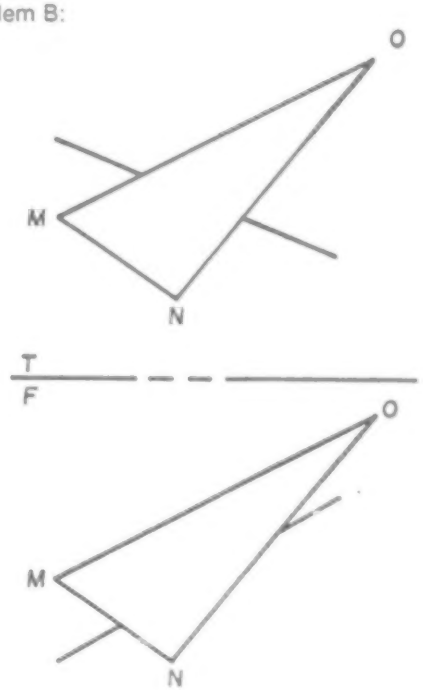


Directions: Complete the following two view drawings showing the visible and hidden lines. Leave projection lines.

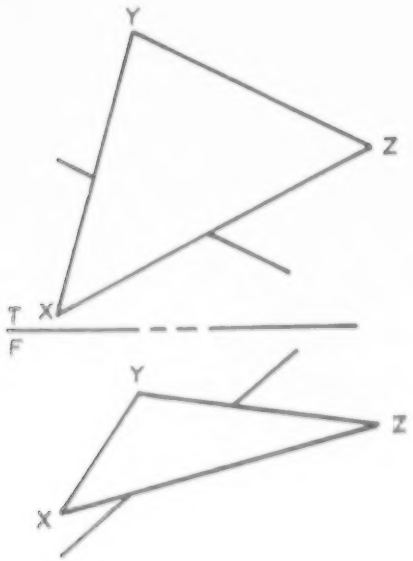
Problem A:



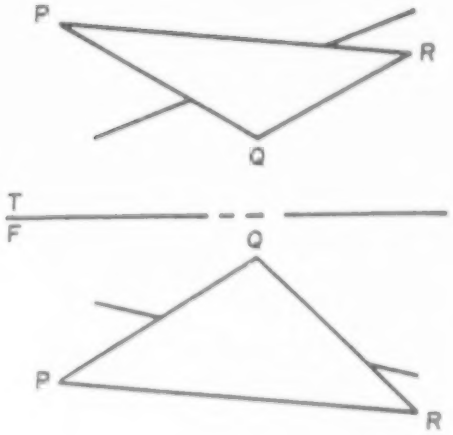
Problem B:



Problem C:



Problem D:

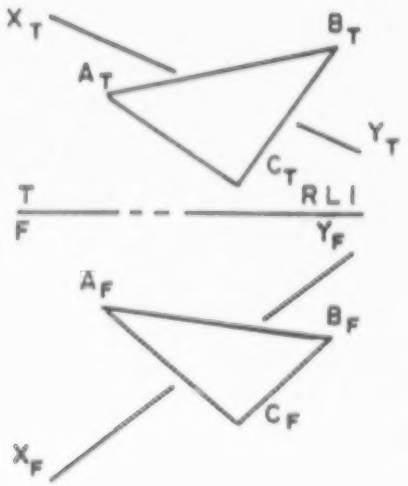


LOCATE PIERCING POINT OF A LINE AND A PLANE

Premise: The piercing point of a line and a plane may be located by constructing a primary auxiliary view. An edge view of a plane and a line is projected from one of the plane and a line is projected from one of the principal views to show intersection. The point where the line intersects the plane is projected to the principal views. The procedure for determining visibility of line is given in AS 1.3 and 1.4. The piercing point of a line and a plane can be located by using the procedure in the following example.

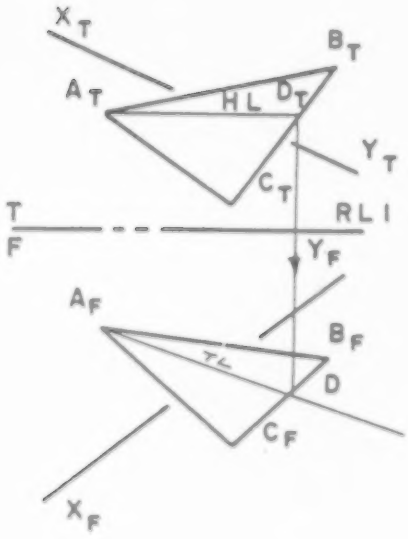
Example:

1. Use given views of line XY and plane ABC

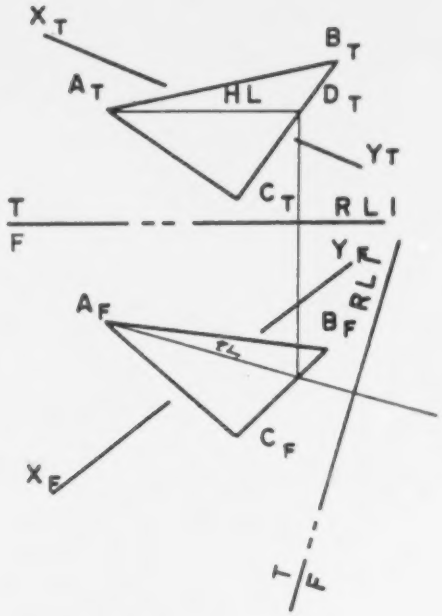


2. Construct line A_T D_T in top view parallel to reference line RL1; then project point D_T to front view, locating point D_F

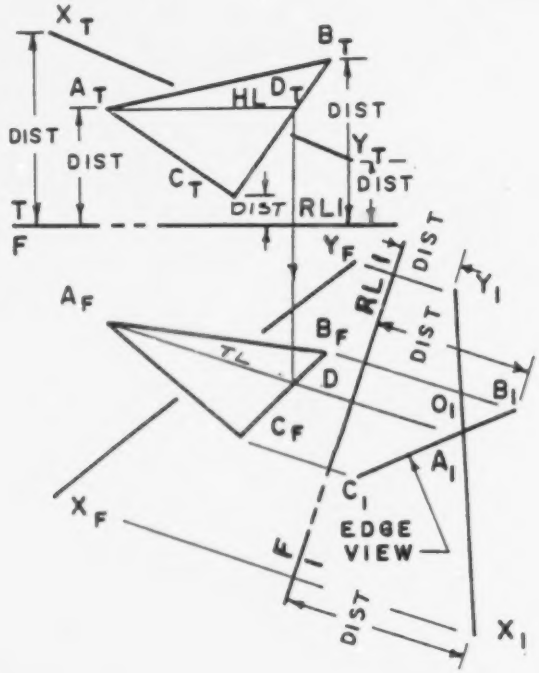
NOTE: Line AD may be constructed parallel to RL1 in front view.



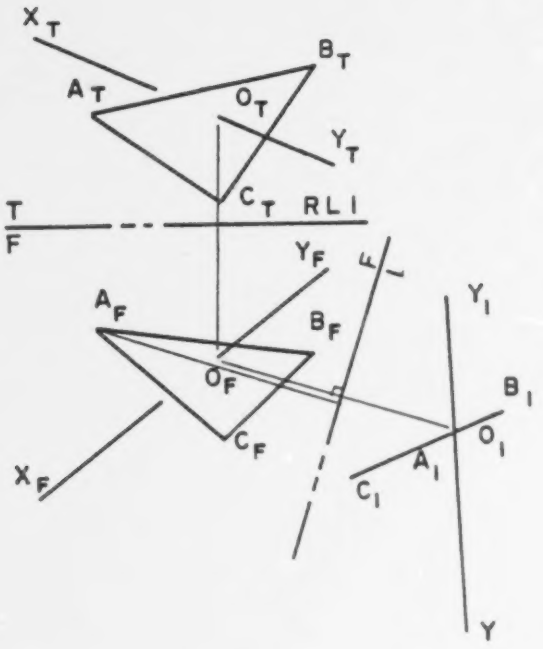
3. Project true length line A_F D_F as line of sight; construct reference line RL2 perpendicular to it



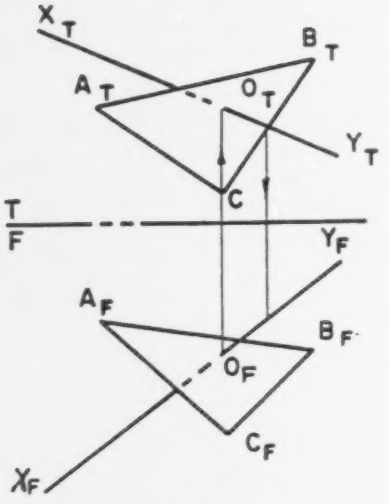
4. Project points A_F, B_F, C_F, X_F, Y_F to auxiliary and transfer distances from top view to establish piercing point 0_1



5. Project the piercing point to front and top views

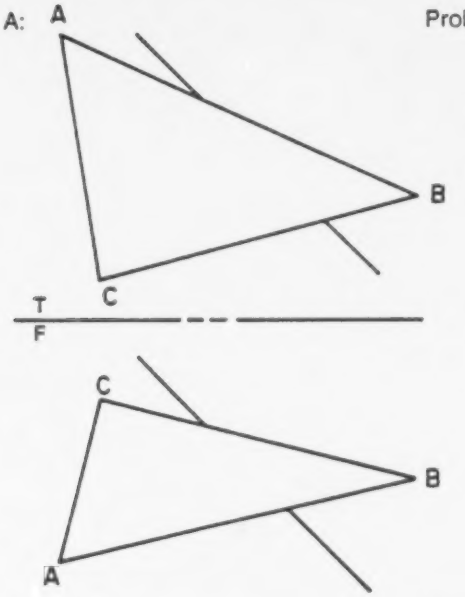


6. Determine visibility of line XY

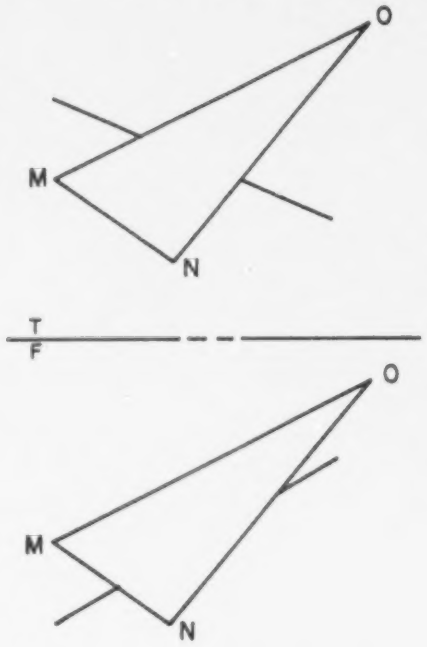


Directions: Determine piercing point of a line and a plane in the following problems. Leave construction lines and determine visibility of lines.

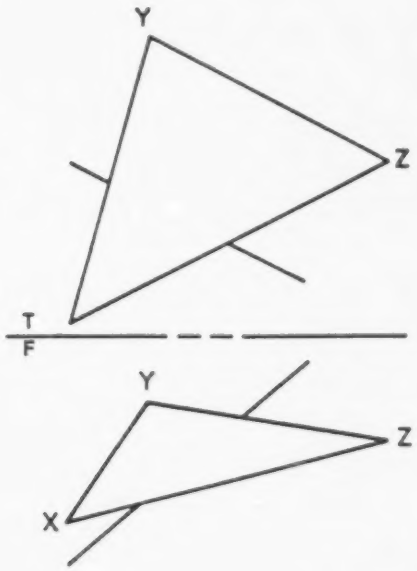
Problem A:



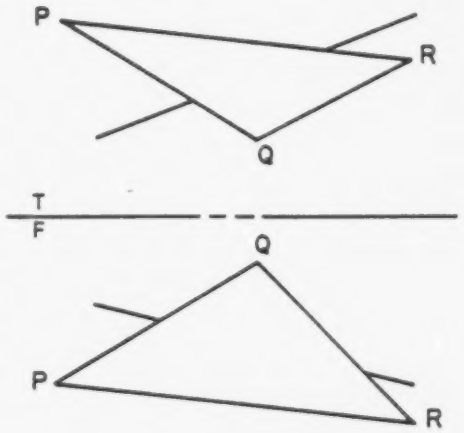
Problem B:



Problem C:



Problem D:

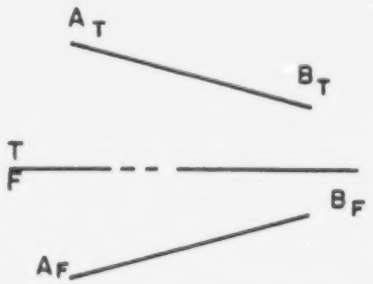


CONSTRUCT POINT VIEW OF A LINE

Premise: Determining the point view of a line is basic for projection of a secondary auxiliary view. The procedure given in the example is for determining point view of only one line. The procedure for finding point view of oblique lines is the same. Point view of a line can be constructed by using the procedure in the following example.

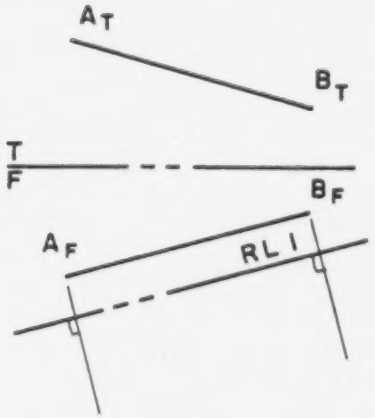
Example:

1. Use given top and front view of line AB

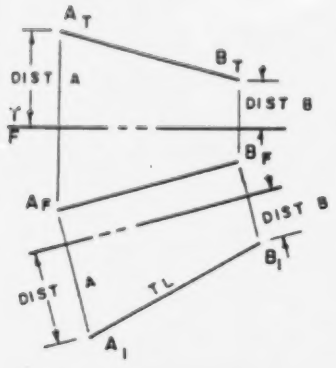


2. Construct reference line RL1 parallel to line $A_F B_F$

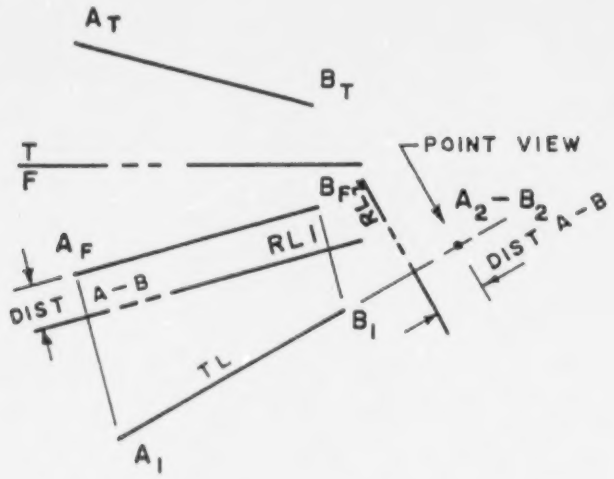
   NOTE: Top view could have been used.



3. Find true length of line $A_F T_F$ by projecting end points from front view, then transfer from top view



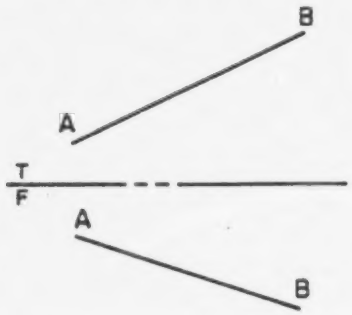
4. Construct reference line RL2 perpendicular to true length line A, B,



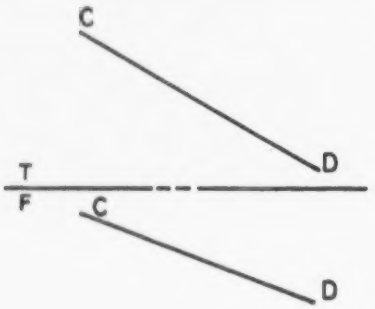
5. To find point view of line, transfer distance from front view and project line A, B, to secondary auxiliary view

Directions: Construct a point view of a line in the following problems. Label end points of lines in construction. Leave construction lines.

Problem A:



Problem B:

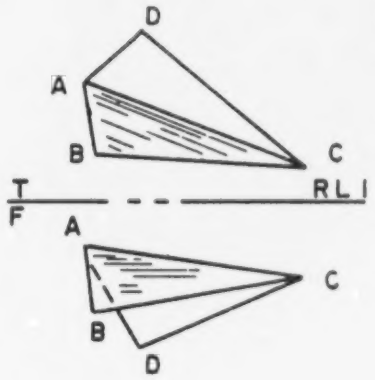


DETERMINE TRUE ANGLE BETWEEN TWO PLANES IN A SECONDARY AUXILIARY

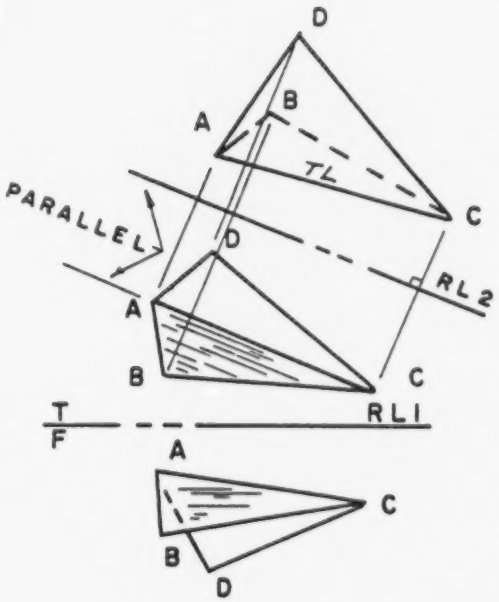
Premise: When the line of intersection between two planes is an oblique line, a secondary auxiliary view is required. True angle between two planes in a secondary auxiliary can be determined by using the procedure in the following example.

Example:

1. Use given top and front views of the two planes



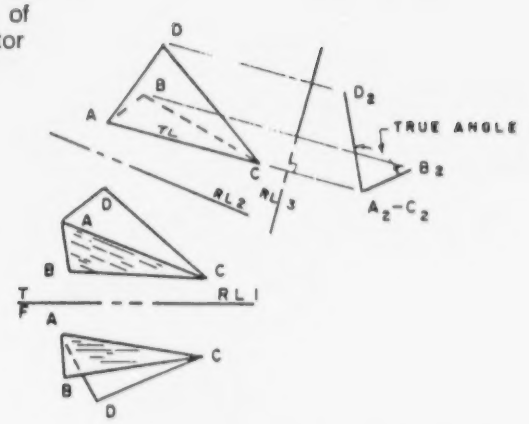
2. Construct primary auxiliary view of planes to determine true length of line of intersection



3. Construct a secondary auxiliary view to determine point view of line of intersection

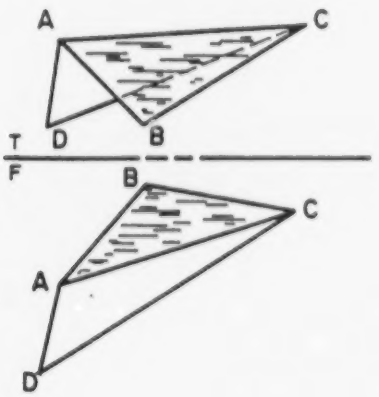
4. Locate points B_2 D_2 by projecting from primary auxiliary view; transfer distances from top view

5. Measure true angle between line of intersection of two planes with protractor

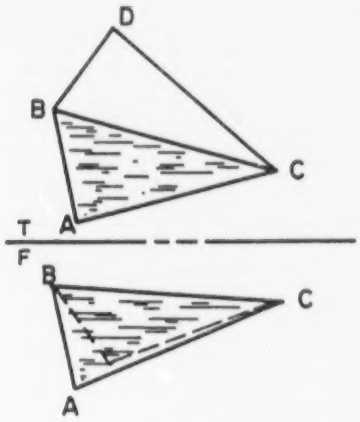


Directions: Determine the true angle between two planes in the following problems. Measure angle with protractor or drafting machine. Leave construction lines.

Problem A:



Problem B:

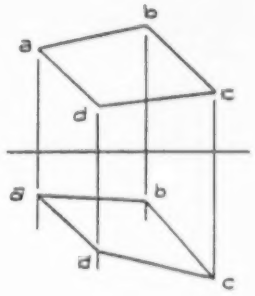


CONSTRUCT A TRUE SIZE AUXILIARY OF AN OBLIQUE PLANE

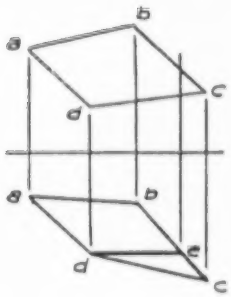
Premise: An oblique plane is at an angle to three principal views. It will not appear true size in any of the views; therefore, it is necessary to draw an auxiliary view of it. Oblique planes are not uncommon on many types of drawings. A simple example is given, but the basic principles will apply for all situations. A true size auxiliary of an oblique plane can be constructed by using the procedure in the following example.

Example:

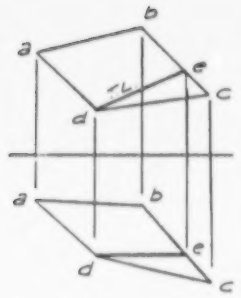
1. Use given surface abcd, top and front view



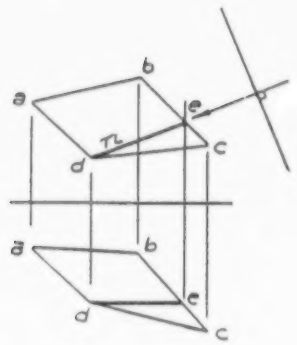
2. Construct a horizontal line either in the top or front view at point a or c in top or point b or d in front; in this example use point d in front and extend it horizontally to line bc making a new point e



3. Project point e to top view until it crosses line bc and draw line d-e in top; line d-e is true length

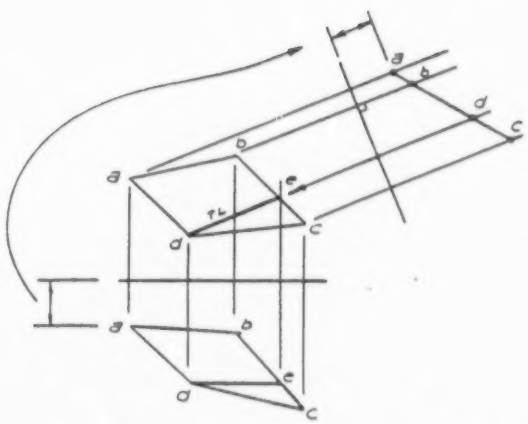


4. Assume a line of sight looking into the end of line d-e; draw reference line perpendicular to line of sight



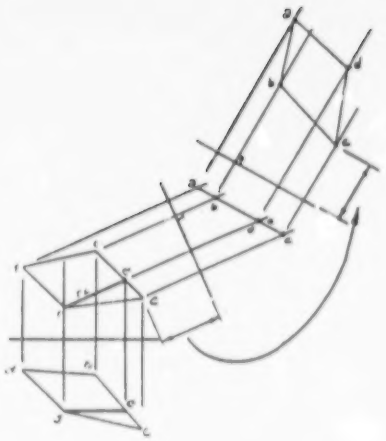
5. Project points abcd through reference line and transfer measurements from front view

NOTE: Points abcd will form a straight line which is an edge view of plane.



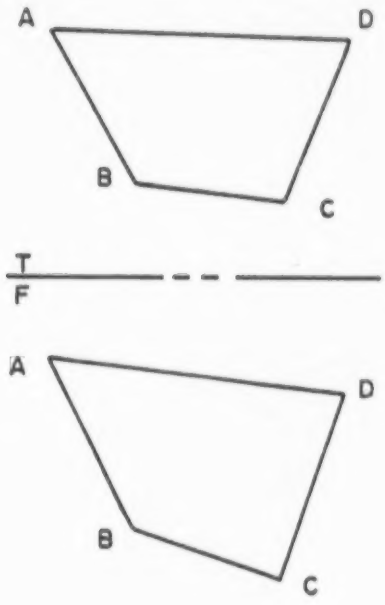
6. Assume a line of sight perpendicular to edge view and draw a true size view of plane abcd by transferring point distances from top view to true size auxiliary view

7. Connect points to form true size of plane

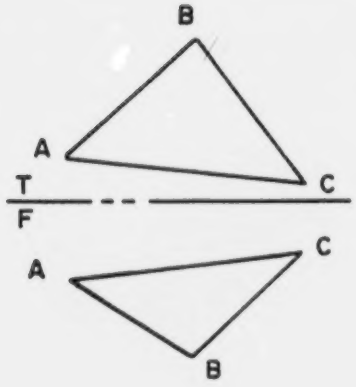


Directions: Construct true size view of the oblique planes in the problems given.

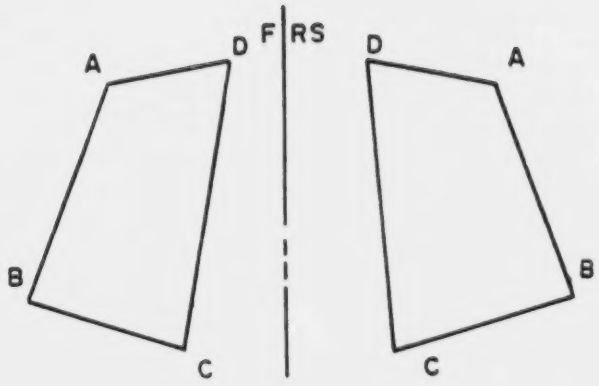
Problem A:



Problem B:



Problem C:

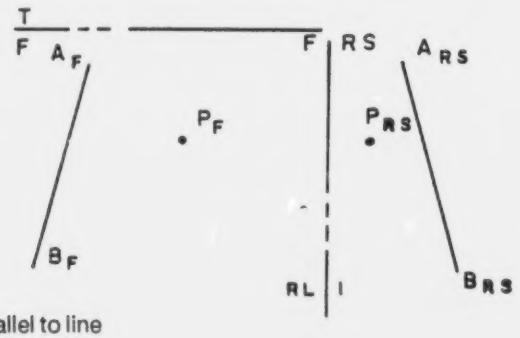


DETERMINE SHORTEST DISTANCE BETWEEN A POINT AND A LINE

Premise: In the manufacture of equipment, it is necessary to determine the clearance distance between parts. The shortest distance is determined by secondary auxiliary view. A distance between a point and a line can be determined by using the procedure in the following example.

Example:

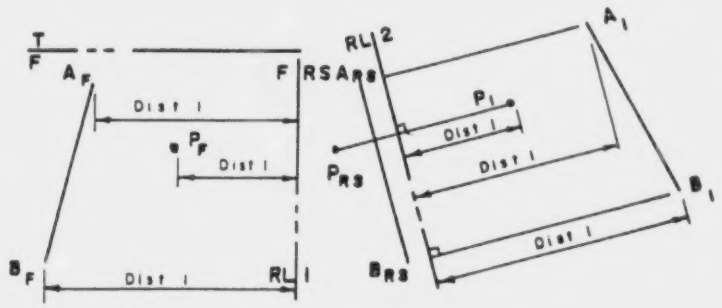
1. Use given front and right side views of the line and point



2. Construct reference line RL2 parallel to line A_{RS} B_{RS}

3. Construct true length of line AB by projecting end points from right side view, then transfer distance from front view

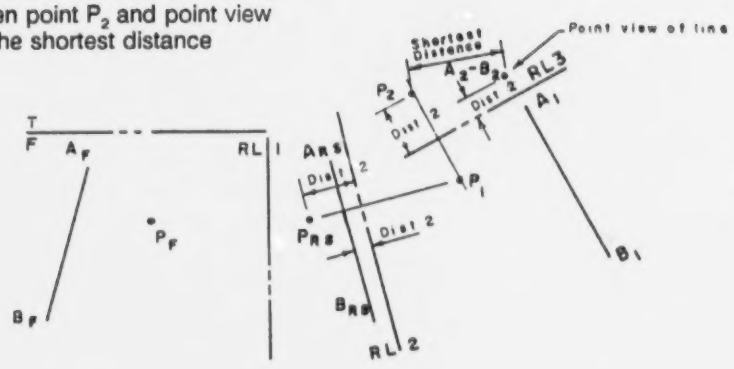
4. Construct point P in primary auxiliary



5. Construct reference line RL3 perpendicular to line A_1 B_1

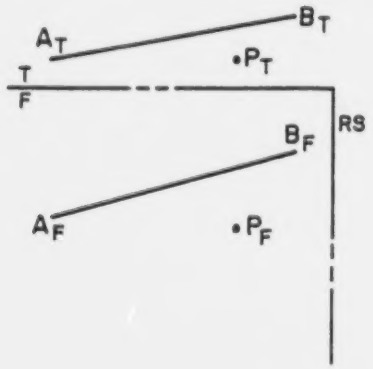
6. Transfer distances M_1 N_1 from primary auxiliary to establish point P_2 and point view of line A_2 B_2

7. Distance between point P_2 and point view of line A_2 B_2 is the shortest distance

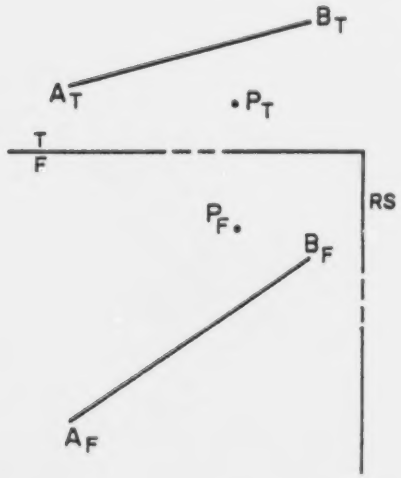


Directions: Using secondary auxiliary procedure, determine shortest distance between a point and a line in the problems given. Measure distance with full size scale.

Problem A:



Problem B:

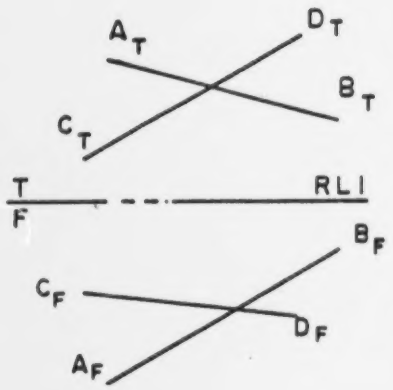


DETERMINE SHORTEST DISTANCE BETWEEN TWO SKEW LINES

Premise: Crossing lines in space are not necessarily intersecting lines. Sometimes it becomes necessary to determine clearance distance between two lines. Shortest distance between two skew lines in a secondary auxiliary can be determined by using the procedure in the following example.

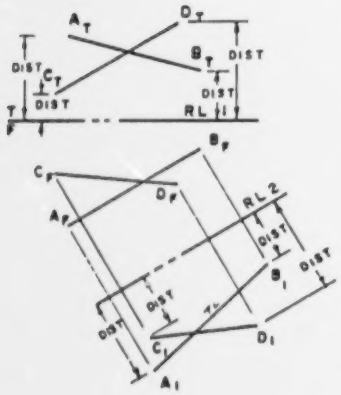
Example:

1. Use given top and front views of two skew lines



2. Construct reference line RL 2 parallel to line A_F B_F in front view

   NOTE: Top view may be used if reference line is constructed parallel to one of the lines.

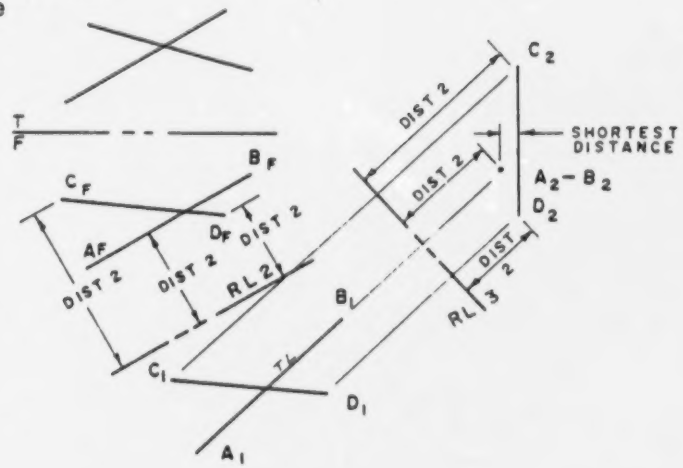


3. Construct primary auxiliary of line A_F B_F to determine true length line

4. Construct reference line RL3 perpendicular to true length line

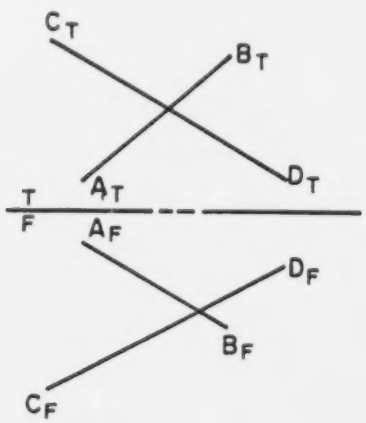
5. Transfer distances from front view to secondary auxiliary view, then project points from primary auxiliary to secondary auxiliary to establish line and point view of a line

6. Distance between line C_2 D_2 and point view of line A_2 B_2 is shortest distance

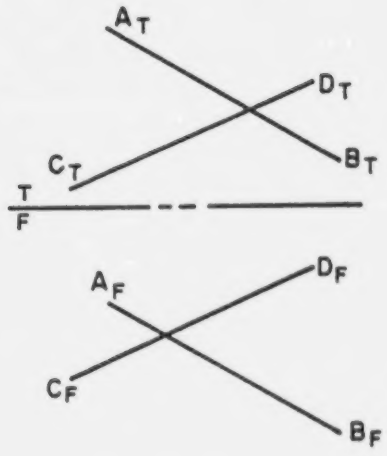


Directions: Determine shortest distance between two skew lines in the problems given. Measure the distance with full size scale.

Problem A:



Problem B:



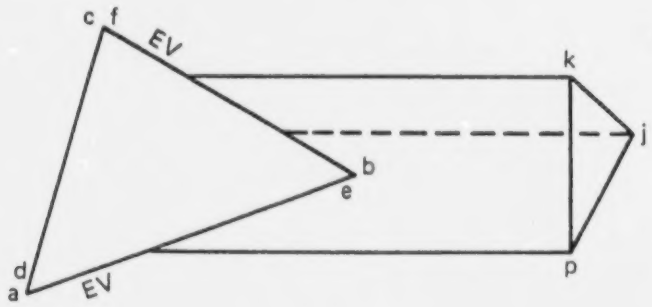
CONSTRUCT INTERSECTIONS OF SURFACES

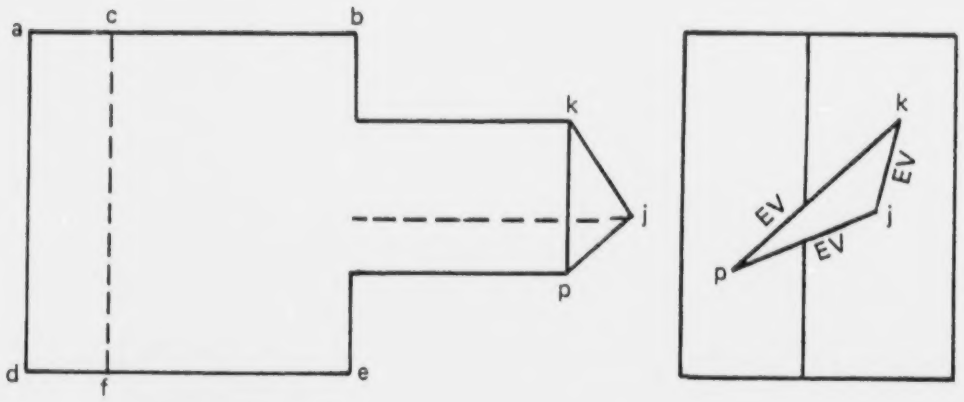
Directions: Construct intersections of surfaces using edge views. The procedure in the following example is to be used as a guideline for solving the problems.

Example:

1. Identify and label all edge views (EV) and label all points

   NOTE: If edge views are not given, use auxiliary views to find them.

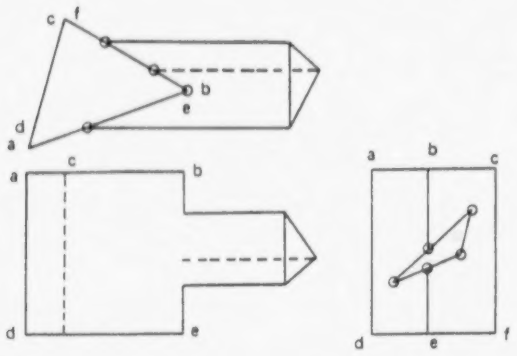




2. Observe edge views and circle points at the end of lines that intersect the edge views-these are called piercing points

   a. Since all three piercing points are not on the same plane, line "be" should also be circled to make the line of intersection continuous.

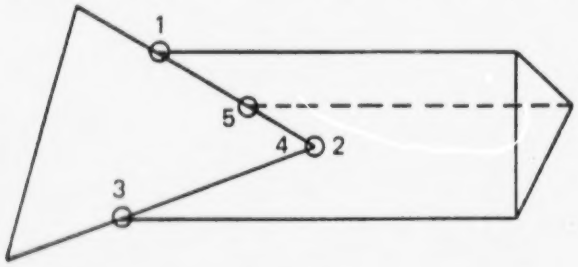
   b. Circle piercing points where "be" intersects the edges in the side view



3. Follow the line of intersection between the two objects numbering them as you go

   a. 1 and 2 are on the same top surface

   NOTE: Point 5 is hidden and is on the bottom surface.



   b. Line 2-3 is on the top surface

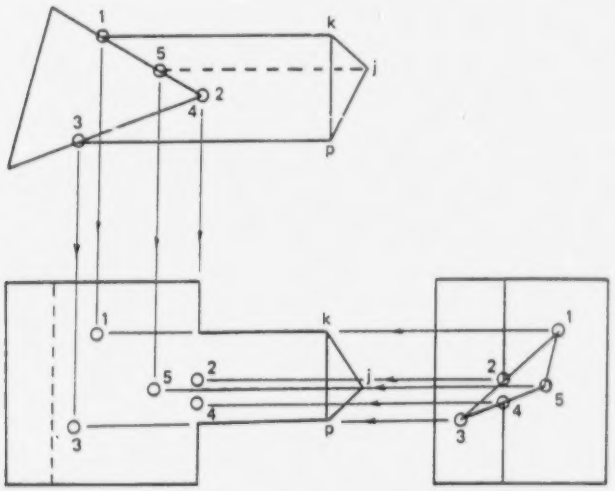
   c. Line 3-4 is on the bottom surface

   d. Line 4-5 is on the bottom surface

   e. Line 5-1 is on the bottom surface

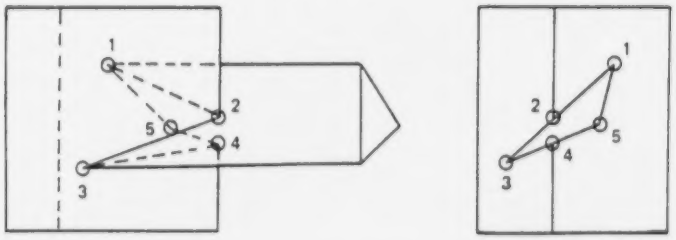
   f. The line of intersection is continuous ending with the same start point; your ability to visualize is very important in this process

4. Project piercing points to front view intersecting corresponding lines; circle intersections



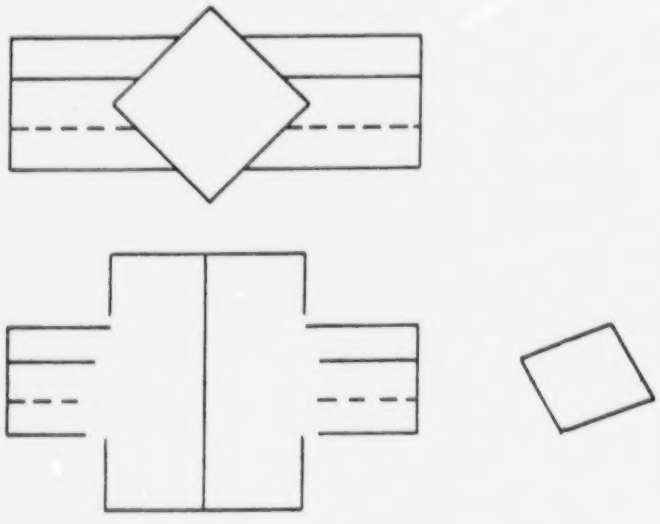
NOTE: Points 2 and 4 must be projected from the side view. Another method for finding the piercing point of a line and a plane is the two-view method which will be covered in Assignment Sheet #9.

5. Connect piercing points to form line of intersection; use visualizing skills to determine visibility and if lines are near the observer or far from the observer



Directions: **Construct line of intersection between the parts shown. Circle piercing points and number line of intersection on all views.**

A.



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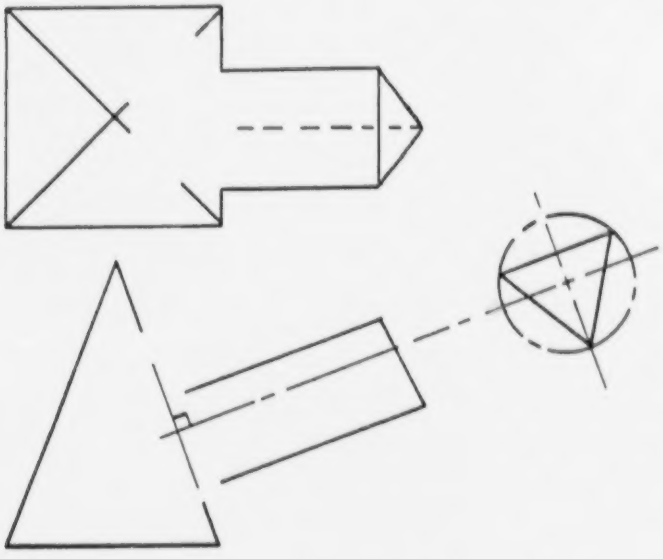

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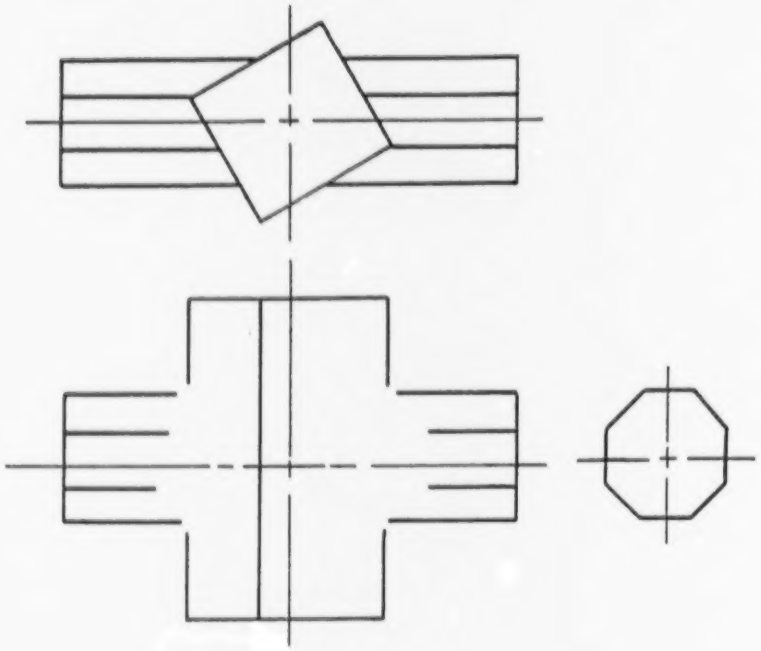

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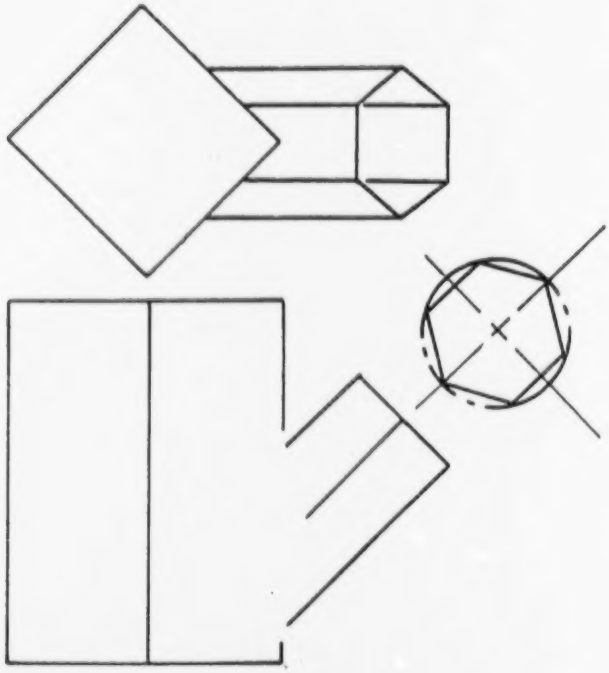
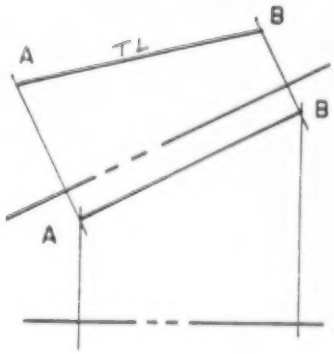


ANSWERS TO ASSIGNMENT SHEETS

AS 1.1

A.



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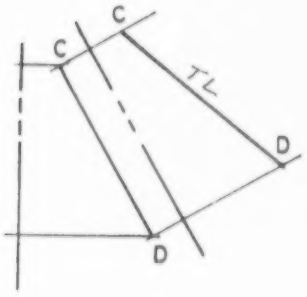

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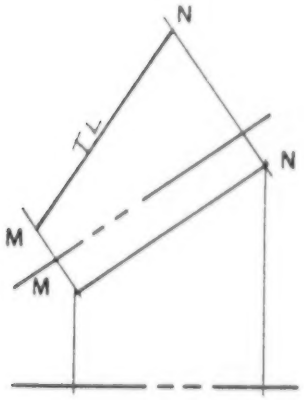

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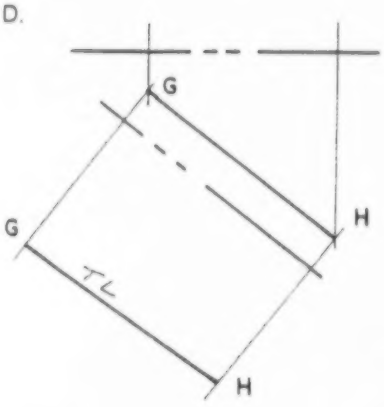
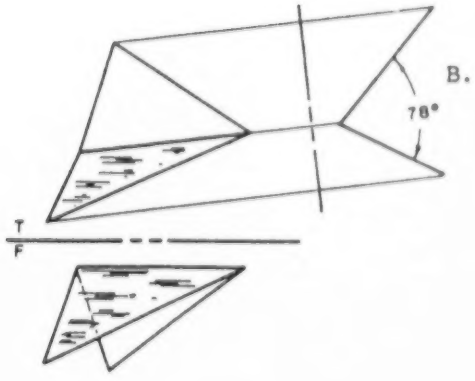


AS 1.2

A.



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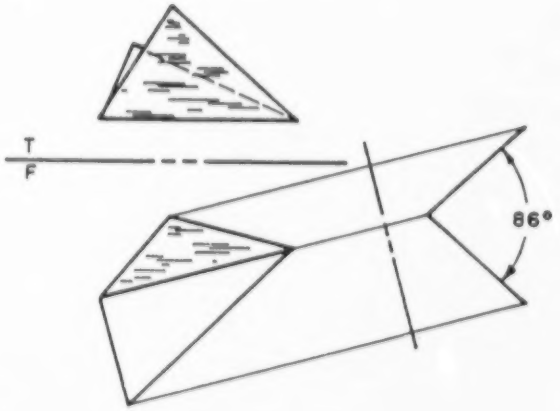

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AS 1.3

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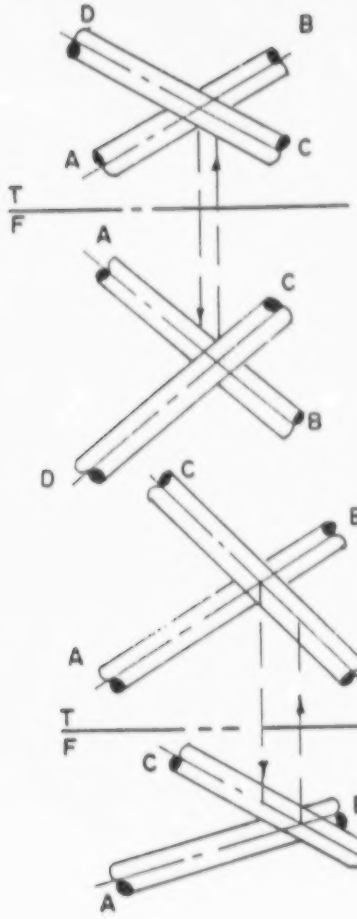

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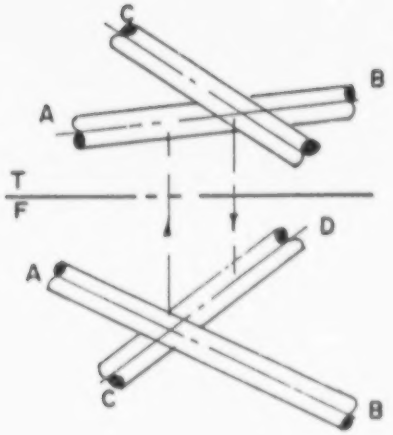
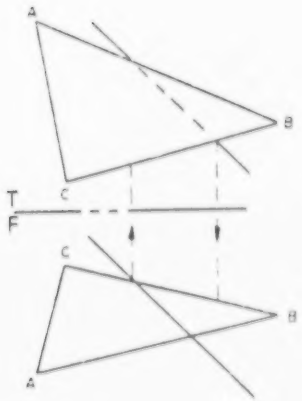


C.

AS 1.4

A.



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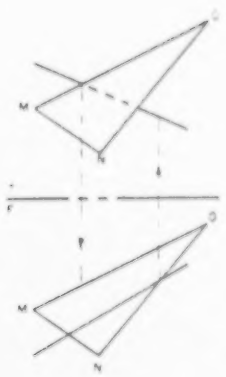

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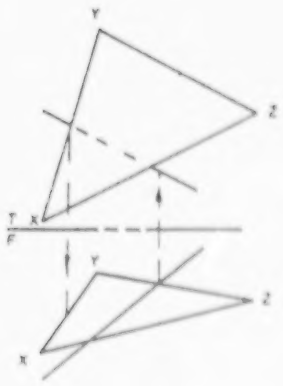
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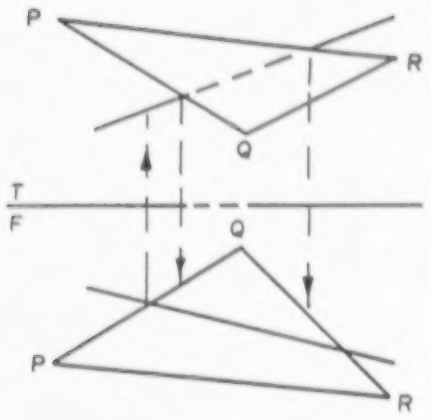
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AS 1.5

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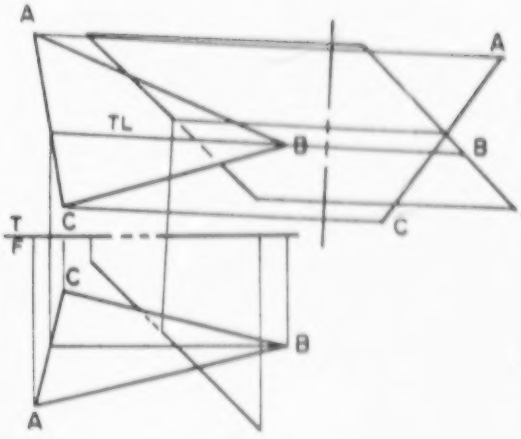
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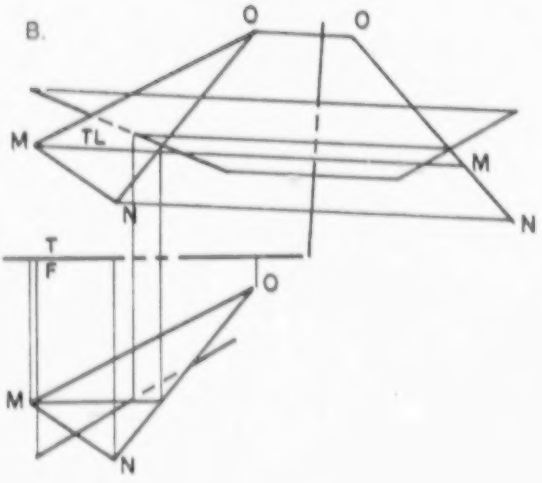
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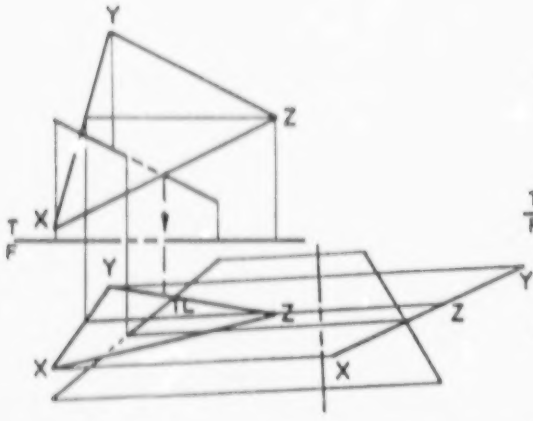
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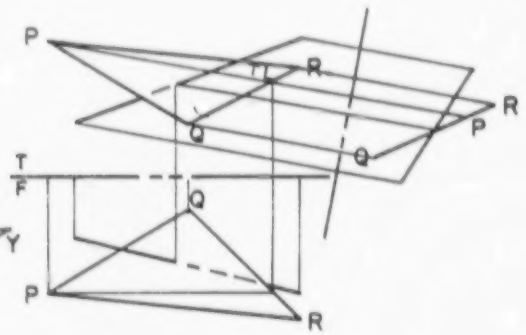
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AS 1.6

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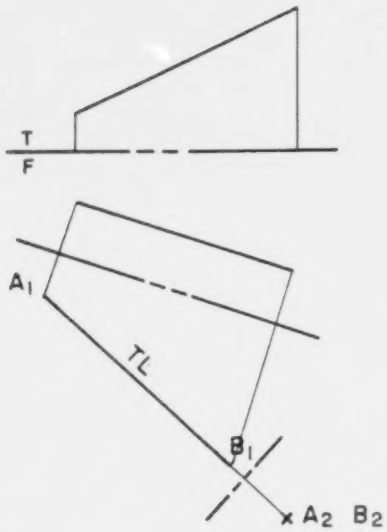

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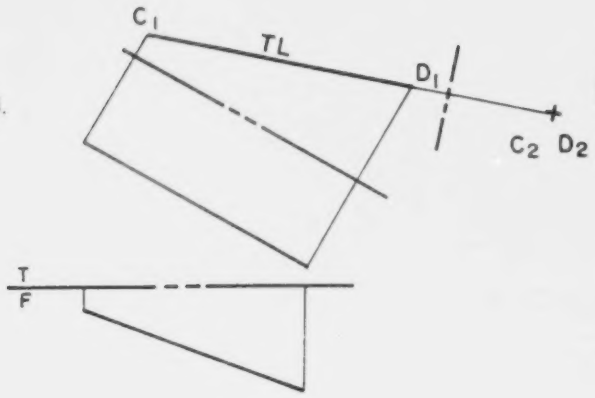
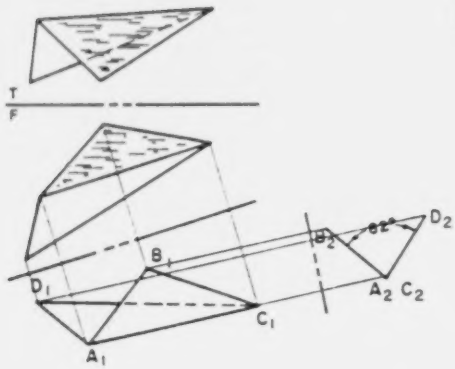


AS 1.7

A.



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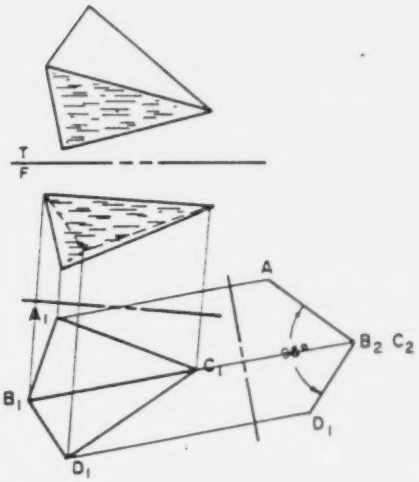
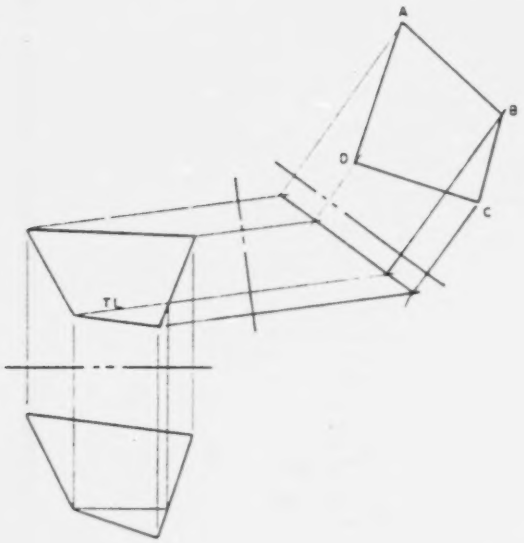


AS 1.8

A.



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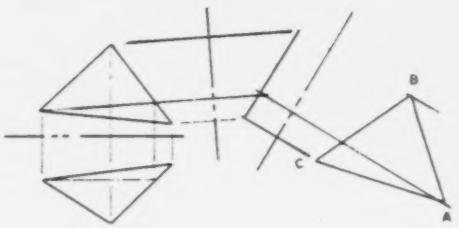

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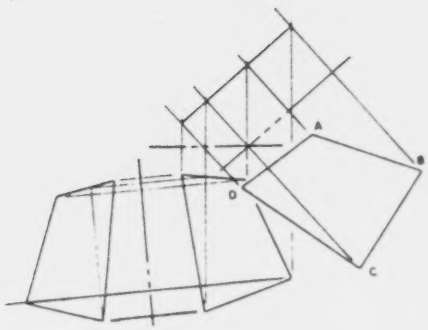
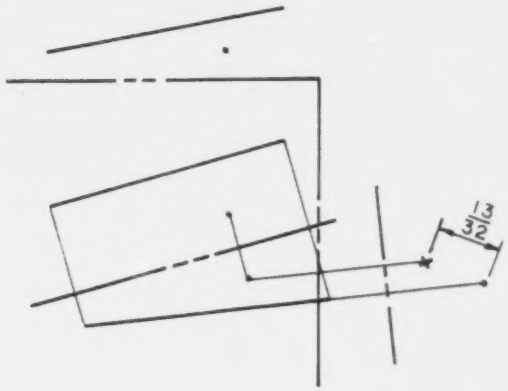
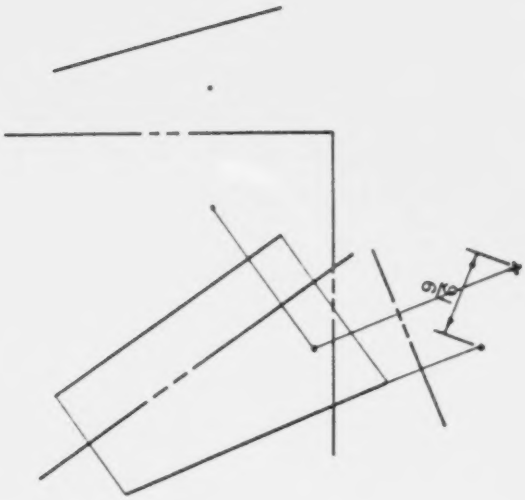


AS 1.9

A.

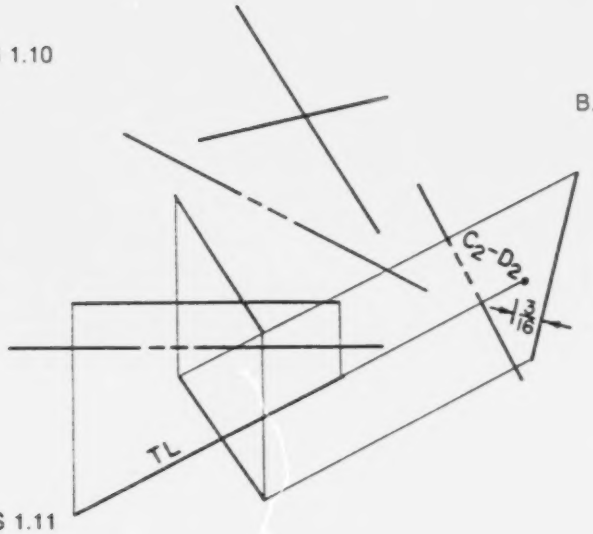


B.

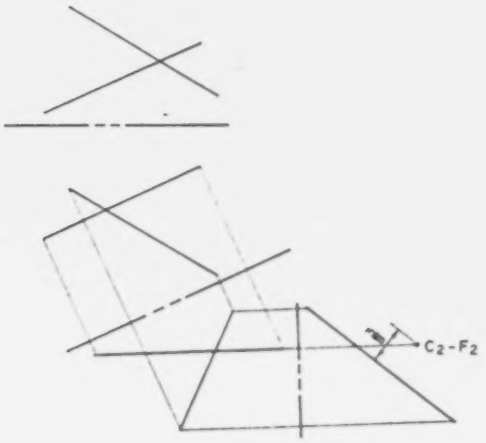


AS 1.10

A.



B.



AS 1.11

Evaluated to the satisfaction of the instructor.

MODULE: RELATED VIEWS AND DESCRIPTIVE GEOMETRY

UNIT III: DESCRIPTIVE GEOMETRY

UNIT TEST

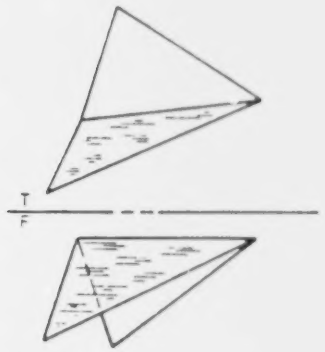
Match the terms on the right with their correct definitions on the left.

____	1.	A line representing the inclined plane	a.	Inclined plane
____	2.	A view or surface that is not perpendicular or right angle to the plane of projection	b.	True size
____	3.	Direction from which an object is being viewed	c.	Auxiliary view
____	4.	A plane that is foreshortened in two principal viewing planes and edge view in one other principal viewing plane	d.	Oblique plane
____	5.	To appear shorter to the eye than it actually is	e.	Edge view
____	6.	A first projection of an inclined plane from one of the principal views	ab.	Line of sight
____	7.	Oblique plane or line projected from a primary auxiliary view and one of the principal views	ac.	Foreshortened
____	8.	A surface that is shown in its actual size	ad.	Primary auxiliary view
____	9.	A plane that is foreshortened in all three principal viewing planes	ae.	Transfer
____	10.	Take from one point or view and put in another view	bc.	Secondary auxiliary view

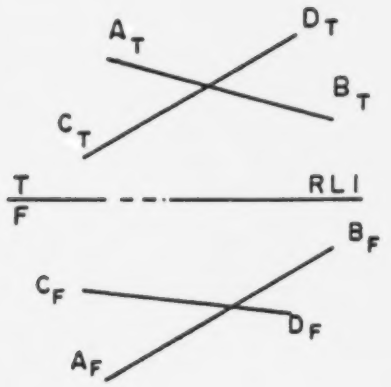
Match the terms on the right with their correct definitions on the left.

____	11.	A line that appears in its actual length	a.	Symmetrical
____	12.	A line at 90° to a given plane of projection	b.	Perpendicular line
____	13.	A common line on back side, center, front side, or between views from which depth measurements are taken	c.	Fold line
			d.	True length line
____	14.	A theoretical line between two views where viewing planes fold	e.	Slope
			ab.	Skew lines
____	15.	Has same shape and size on opposite sides of a center line	ac.	Reference line
____	16.	Nonintersecting lines, not parallel to each other or to the principal views		
____	17.	An angle formed by two intersecting planes		

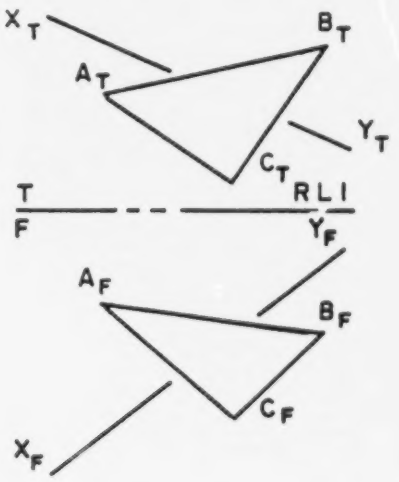
18. **Determine the true angle between two planes.**



19. **Find distance between 2 lines**



20. **Find point of intersection between line and plane.**



21. **List the different locations of a reference line.**

a. _____

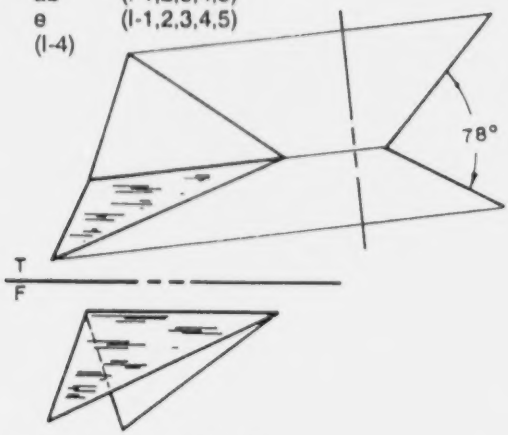
b. _____

c. _____

d. _____

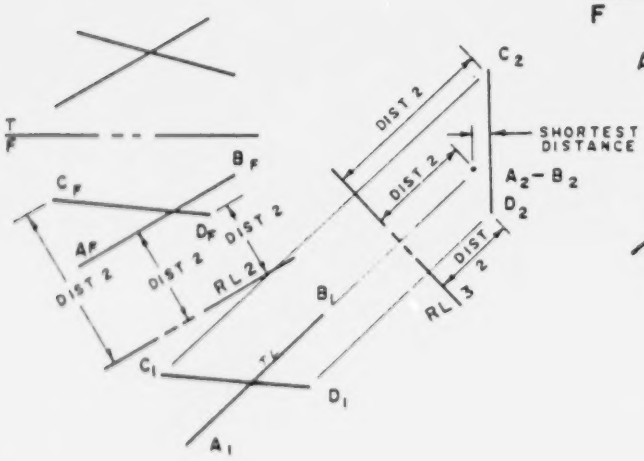
ANSWERS TO UNIT III TEST

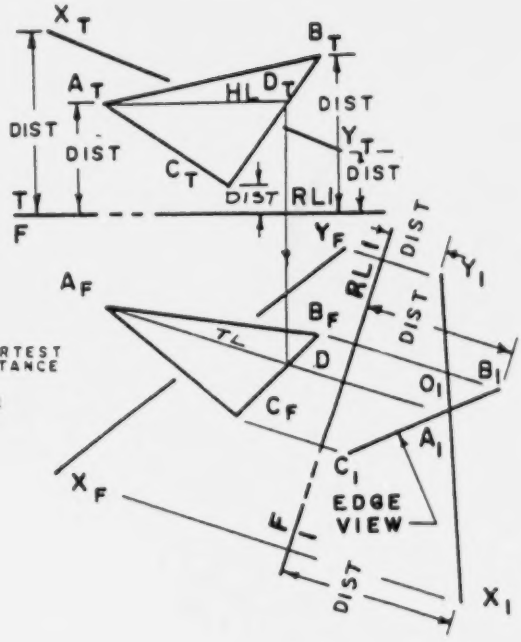
1.	e	(I-1,2,3,4,5)
2.	c	(I-1,2,3,4,5)
3.	ab	(I-1,2,3,4,5)
4.	a	(I-1,2,3,4,5)
5.	ac	(I-1,2,3,4,5)
6.	ad	(I-1,2,3,4,5)
7.	bc	(I-1,2,3,4,5)
8.	b	(I-1,2,3,4,5)
9.	d	(I-1,2,3,4,5)
10.	ae	(I-1,2,3,4,5)
11.	d	(I-1,2,3,4,5)
12.	b	(I-1,2,3,4,5)
13.	ac	(I-1,2,3,4,5)
14.	c	(I-1,2,3,4,5)
15.	a	(I-1,2,3,4,5)
16.	ab	(I-1,2,3,4,5)
17.	e	(I-1,2,3,4,5)
18.	(I-4)	



19. (I-4)

20. (I-4)



21. The following in any order: (I-1,2,3,4,5)

a. Back edge of view
b. Center line
c. Front edge of view
d. Between views